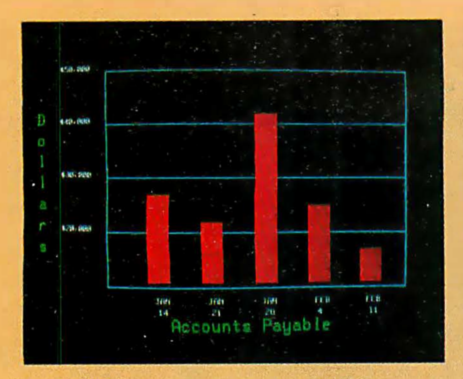
SEPTEMBER 1980 Volume 5, Number 9 $2.50 in USA/$2.95 in Canada

BYTE®

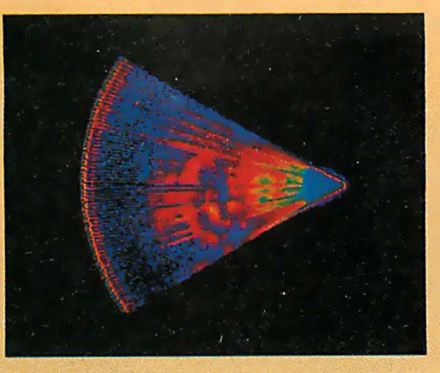
the small systems journal

A McGRAW-HILL PUBLICATION

HOMEBREWING



Management Information Display


Ultrasonic heart sector scan



High-resolution display with alphanumerics

Get the professional color display that has BASIC/FORTRAN simplicity

LOW-PRICED, TOO

Here's a color display that has everything: professional-level resolution, enormous color range, easy software, NTSC conformance, and low price.

Basically, this new Cromemco Model SDI* is a two-board interface that plugs into any Cromemco computer.

The SDI then maps computer display memory content onto a convenient color monitor to give high-quality, high-resolution displays (756 H x 482 V pixels).

When we say the SDI results in a high-quality professional display, we mean **you can't get higher resolution than this system offers in an** NTSC-conforming display.

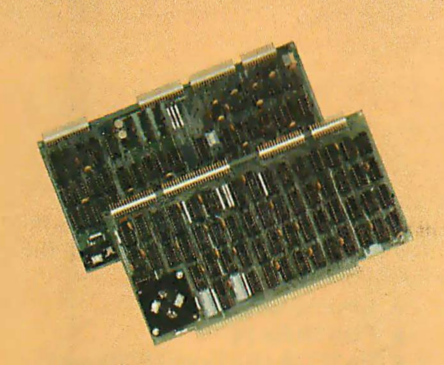
The resolution surpasses that of a color TV picture.

BASIC/FORTRAN programming

Besides its high resolution and low price, the new SDI lets you control with optional Cromemco software packages that use simple BASIC- and FORTRAN-like commands.

Pick any of 16 colors (from a 4096-color palette) with instructions like DEFCLR (c, R, G, B). Or obtain a circle of specified size, location, and color with XCIRC (x, y, r, c).

*U.S. Pat. No. 4121283


Model SDI High-Resolution Color Graphics Interface

HIGH RESOLUTION

The SDI's high resolution gives a professional-quality display that strictly meets NTSC requirements. You get 756 pixels on every visible line of the NTSC standard display of 482 image lines. Vertical line spacing is 1 pixel.

To achieve the high-quality display, a separate output signal is produced for each of the three component colors (red, green, blue). This yields a sharper image than is possible using an NTSC-composite video signal and color TV set. Full image quality is readily realized with our high-quality RGB Monitor or any conventional red/green/blue monitor common in TV work.



Model SDI plugs into Z-2H 11-megabyte hard disk computer or any Cromemco computer

DISPLAY MEMORY

Along with the SDI we also offer an optional fast and novel **two-port** memory that gives independent high-speed access to the computer memory. The two-port memory stores one full display, permitting fast computer operation even during display.

CONTACT YOUR REP NOW

The Model SDI has been used in scientific work, engineering, business, TV, color graphics, and other areas. It's a good example of how Cromemco keeps computers in the field up to date, since it turns any Cromemco computer into an up-to-date color display computer.

The SDI has still more features that you should be informed about. So contact your Cromemco representative now and see all that the SDI will do for you.





Here's the state of the art in low-cost hard-disk computers

11 MEGABYTES OF FAST HARD-DISK STORAGE

Yes, the Cromemco Model Z-2H is in a class by itself in the computer field.

These Z-2H features tell you why:

- **11 megabytes of hard-disk storage**
- **64 kilobytes of fast RAM**
- **Two dual-sided floppy disk drives**
- **Z-80A type processor**
- **Fast 4 MHz operation—150 nanosecond access time**
- **Fast hard-disk transfer rate of 5.6 megabits/second**
- **Low cost**

And that's not all you get. Not nearly.

BROAD SOFTWARE SUPPORT

You also get Cromemco software support—the broadest software support in the microcomputer field. Software that Cromemco is known for. Like this:

- **Structured BASIC**
- **FORTRAN IV**
- **RATFOR (RATional FORtran)**
- **COBOL**
- **Z-80 Macro Assembler**
- **Word Processing System**
- **Data Base Management**

And more all the time.

FIELD PROVEN

The Z-2H is clearly in a class by itself. We introduced it last summer. It's field proven. It's reliable.

And it's rugged. Housed in a sturdy, all-metal cabinet.

EASILY EXPANDABLE

As always with Cromemco, you get expandability. The fast 64K RAM in this Model Z-2H can be expanded to 512 kilobytes. That amount of RAM combined with 11 megabytes of hard-disk storage gives you enormous computer power—the equal or even beyond what much larger computers sometimes offer.

What's more, this computer gives you a 12-slot card cage. That's to plug in your special circuits as well as additional RAM and interface cards.

This expandability is supported by still more Cromemco value — the Z-2H's heavy-duty power supply that gives you 30A at 8V and 15A at ±18V to support plug-ins.

LOW COST — SEE IT NOW

The Z-2H is real. It's been in the field for many months. It's proven itself.

You should see the Z-2H now. Contact a Cromemco representative and arrange for a demo. Learn that Cromemco is a survey-winner for reliability.

And learn that the Z-2H is under $10K.

In the long run it always pays to get the best.

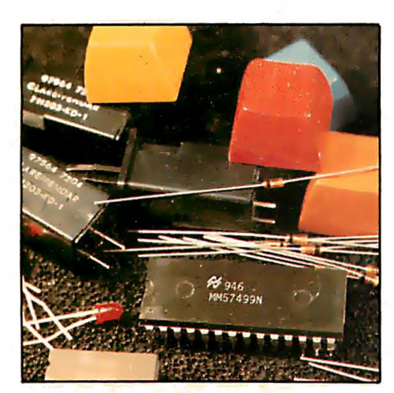


Circle 1 on inquiry card.

McGraw-Hill

In The Queue

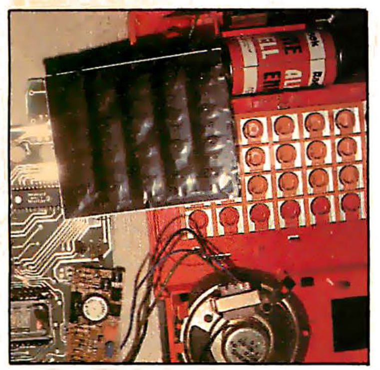
BYTE September 1980
Volume 5, Number 9



Page 26



Page 46


Page 76


Page 126

Foreground

Background

Nucleus



About This Issue

BYTE is five years old this month, and we're taking the opportunity to discuss one of our favorite subjects: *homebrewing*. Much of the personal computer hardware sold today is already assembled; even so, many of our readers like to build or modify their own equipment, and even "homebrew" it from scratch. The cover photograph by Raoul Hackel, Stock Boston, shows some colorful wiring harnesses inside a computer chassis, a familiar sight to the intrepid do-it-yourselfer.

Theme articles in this issue include a build-it-yourself, low-cost, remote data-entry terminal (from Steve Ciarcia); exploring the TI Speak & Spell; a pennypincher's joystick interface; and the beginning of a multipart article on building an 8088 processor for the S-100 bus. Along with these are features on threaded code; FCC regulations and your personal computer; machine problem-solving; some tax hints for personal computer owners; and much more.

You've probably noticed that this issue of BYTE is on the large side. In fact, it's the biggest issue we've ever printed. The extra space allows us to bring you even more articles and features in this issue and in the coming months. . . . CM

Officers of McGraw-Hill Publications Company: Paul F. McPherson, President; Executive Vice Presidents: James E. Boddorf, Gene W. Simpson; Group Vice President: Daniel A. McMillan; Senior Vice President-Editorial: Ralph R. Schulz; Vice Presidents: Kemp Anderson, Business Systems Development; Stephen C. Croft, Manufacturing; Robert B. Doll, Circulation; James E. Hackett, Controller; William H. Hammond, Communications; Eric B. Herr, Planning and Development; John W. Patten, Sales; Edward E. Schirmer, International.

Officers of the Corporation: Harold W McGraw Jr, President, Chief Executive Officer and Chairman of the Board; Robert F Landes, Senior Vice President and Secretary; Ralph J Webb, Treasurer.

BYTE is published monthly by BYTE Publications Inc, 70 Main St, Peterborough NH 03458, a wholly-owned subsidiary of McGraw-Hill, inc. Address all mail except subscriptions to above address: phone (603) 924-9281. Address subscriptions, change of address, USPS Form 3579, and fulfillment questions to BYTE Subscriptions, PO Box 590, Martinsville NJ 08836. Controlled circulation postage paid at Waseca, Minnesota 56093 - USPS Publication No. 528890 (ISSN 0360-5280). Canadian second class registration number 9321. Subscriptions are $18 for one year, $32 for two years, and $46 for three years in the USA and its possessions. In Canada and Mexico, $20 for one year, $36 for two years, $52 for three years. $32 for one year air delivery to Europe. $32 surface delivery elsewhere. Air delivery to selected areas at additional rates upon request. Single copy price is $2.50 in the USA and its possessions, $2.95 in Canada and Mexico, $4.00 in Europe, and $4.50 elsewhere. Foreign subscriptions and sales should be remitted in United States funds drawn on a US bank. Printed in United States of America.

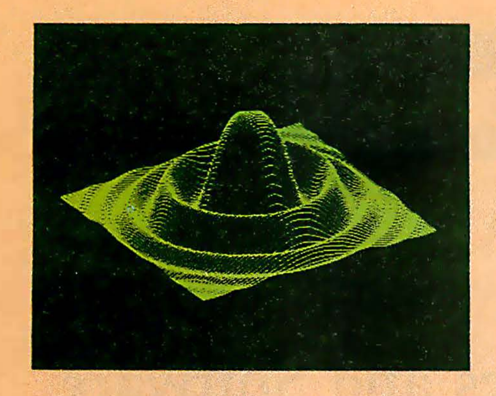
BYTE® is available in microform from University Microfilms International, 300 N Zeeb Rd, Dept PR, Ann Arbor MI 48106 USA or 18 Bedford Row, Dept PR, London WC1R 4EJ ENGLAND.

Subscription WATS Line: (800) 258-5485
Office hours: Mon-Thur 8:30 AM - 4:30 PM, Friday 8:30 AM - Noon, Eastern Time

Member


Audit Bureau of Circulations

Circle 2 on inquiry card. →

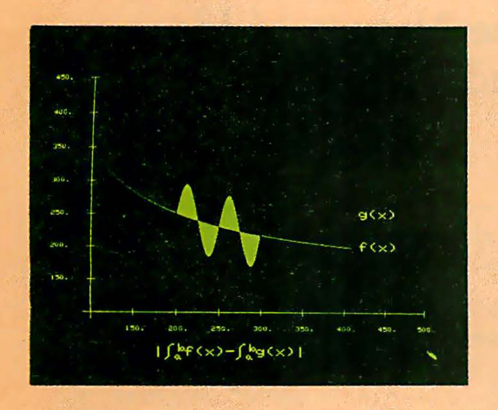


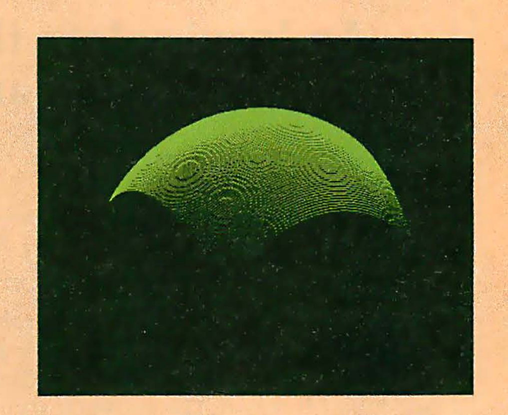
MICROANGELO

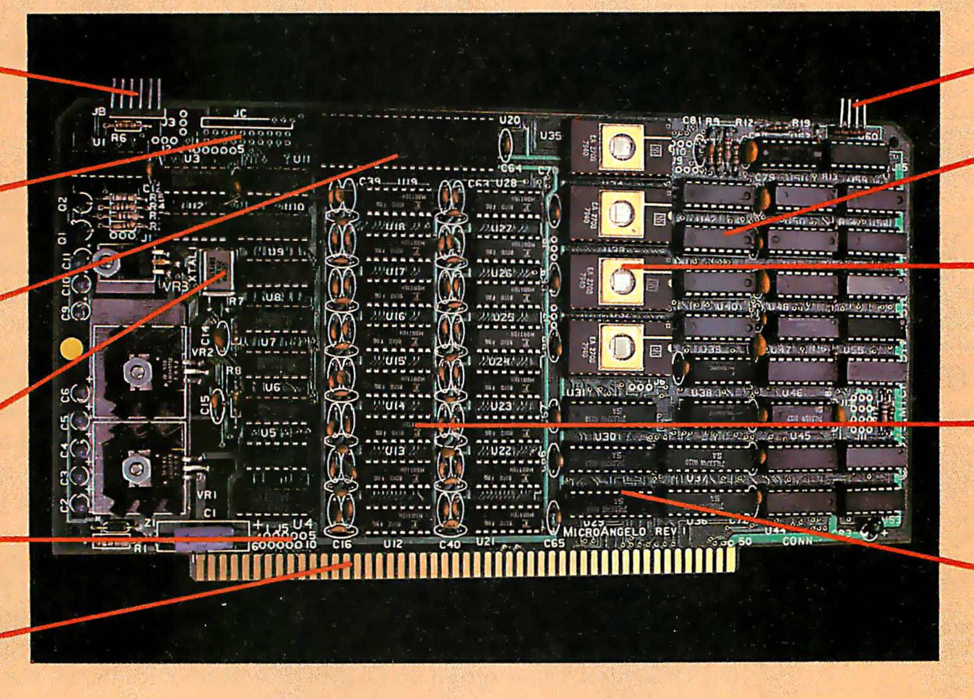
HIGH RESOLUTION GRAPHICS SINGLE BOARD COMPUTER

by

SCION
CORPORATION







Screenware™ Pak I

A 4K byte operating system resident in PROM on MicroAngelo™ Pak I emulates an 85 character by 40 line graphics terminal and provides over 40 graphics commands. Provisions exist for user-defined character sets and directly callable user extensions to Screenware Pak I.

Host Resident Terminal Software

An interface software package that coordinates input/output from the MicroAngelo™ graphics board, the MicroAngelo™ keyboard, and your computer. The result is a flexible, yet sophisticated graphics terminal.

Editorial

Intellectual Ethics and Software

An Inquiry Into the Nature of Ideas, Academia, and Commerce

Carl Helmers

Recently, I encountered an old problem again. A problem in this sense is a body of questions and my tentative answers. An old problem is like an old jacket. You get familiar with the intricacies of its individual creases, wrinkles, and holes. It may not be currently stylish, or even in the best of conditions. Yet it is hardly worth throwing out because of a shared body of experience. So, I had long ago packed this problem away in my mental baggage.

The problem I refer to is ethical in nature; it has epistemological attributes as well. It is the problem of interfacing the world of ideas with the world of commerce. In its simplest form it is a two-part question: "who originated an idea?" and "what is the value of that idea?" The problem, which has great practical implications in our technological civilization, is that of encouraging innovation by means of rewards in the worlds of ideas and commerce. The ethical position implicit in my viewpoint is simple honesty. Its intellectual expression is that credit should be given where credit is due in a freely operating world of ideas. In a laissez-faire world of commerce, its expression is that value in the marketplace should be given where value is due, in a framework of freely chosen relationships.

We humans have two worlds of activity: the intellectual world and the world of commerce. Each has its own characteristics. One deals with ideas and thoughts freely expressed. The other deals with material goods freely traded in the marketplace. We can engage in both of these very natural human pursuits to the extent that we are politically free of arbitrary laws and interference.

What, you might ask, brings about a discussion of ethics in the marketplace at this time? The particular impetus to this discussion is an incident that came to my knowledge at a recent trade show. Inasmuch as the incident is far from closed, I will not disclose the names of the parties involved. But the situation in its abstract form is worth using to explore some of the ethical problems of commerce in ideas, particularly software for small computers.

Several years ago, a small group of academics began pursuing a particular line of inquiry that related to the nature of computer design for human interaction. The charter of this group of researchers might have been expressed as: "Find the problems of human interaction with computers, and experiment with any solutions you may find." As in any academic pursuit, the inquiry generated many published papers over more than a decade. The fact that these papers also generated some exciting hardware and systems software entered the picture along the way.

Both the software and hardware developments of this group's research have been and are generously underwritten by the sponsoring organization where the activity takes place. In fact, the sponsoring organization did not expect the research to have any immediate practical expression in the marketplace, because it was basic research.

"For reliable data storage, I recommend systems with Shugart disk drives."

Tom Knight, President–
Nycom, Los Altos, California

"The last thing you need when you put your personal computer or small business system to work is a disk drive that you can't rely on. If the drive quits, your system is out of business."

That's why more and more manufacturers and dealers depend on Shugart disk drives for reliable data storage. These professionals don't want disk drive problems any more than you do. Shugart has a large family of drives, too—in all sizes and capacities to suit your system storage needs. For the smaller system, the original 5¼-inch Minifloppy™ stores 250 to 500 kilobytes (single or double-sided)—that's about 50 to 100 pages of printed material. Our single and double-sided 8-inch floppys store 800 to 1600 kilobytes. And for systems that need a larger data base, our 8-inch or 14-inch fixed disk drives store from 5 to 58 megabytes. No other manufacturer offers such a wide variety of disk storage for personal computer and small business systems.

Word processing, general business, accounting—big system or small, you can rely on Shugart drives. We're known as the Headstrong company for good reason. We're Headstrong about reliability, quality, and value. Ask your dealer. He knows us.

Rely on the Headstrong Company.

TM–Minifloppy is a trademark of Shugart Associates.



475 Oakmead Parkway, Sunnyvale, California 94086

Naturally, the members of the group communicated with others at similar academic and industrial research laboratories of the land, by means of conversations at conferences and meetings, as well as written communications of academic professional organizations. This type of communications between peers is an essential part of any productive research field. In short, word of their ideas got out.

Enter the publicist.

Now, intellectually and ethically we cannot argue with the following thought: when an opportunity is available to pursue some perceived value, we should go ahead and pursue it. There is no way one could complain about this kind of action since it is the essence of human activities. This attitude is a prelude to all research and innovation.

The publicist had all the *right* words. He was fluent in the jargon of computers. He perceived the enthusiasm with which the researchers described their activities personally and in print. He thought it would be good to tell the world about what was going on. And that is what he proceeded to do by means of a self-published work which was indeed ahead of the technology of practical general-purpose microcomputers.

Up to this point, our publicist had done nothing to which we could object. He was taking published works, analyzing them and pointing out the implications that these works have. But having caught the enthusiasm, he was beginning to grow impatient. After all, our researcher friends are involved in research, not in entrepreneurial activities. What our publicist had done, however, was create among people stimulated by small computers an intellectual and commercial demand for an excellent concept.

Enter the entrepreneurial programmer. He is the archetypal programmer who, given a challenge, immediately proceeds to code. Probably as a result of the ballyhoo created by the publicist, the entrepreneurial programmer proceeded to dig up the published works of our thinker friends.

These works were indeed complete, and can be found in the technical journals published during the 1970s. They even include all the information necessary for the entrepreneurial programmer to implement a version of one of the crude, early approaches our researcher friends investigated in their pursuit of the problem. Now, as a published work, these documents were intended for use by other researchers and anyone else with a programming problem.

The problem arises when we examine the manner in the which the publicist was going to use the published works of our researchers. It is one thing to implement a version of a program and sell the particular example as a toy. But it is quite another thing to name it the same as our researchers' ongoing project, imply in advertising that it is the same (when it is not), and generally imply that its use is sanctioned by its original authors at the research establishment. This is not the same as simply crediting the source in a published work and proceeding to implement a version under a different name and with particular variations.

Here, we find the complicity of the publicist and the entrepreneurial programmer as a pair. The publicist now had an opportunity to reach for the brass ring of the software that our research friends had not yet made available to him. He found the ring in the entrepreneurial programmer's product. So, the publicist has recently been pushing the entrepreneurial programmer's product at whatever forum he can find. This situation had been fermenting for some time when all parties showed up at a recent convention.

The situation came to a head at the convention when our researcher friends arrived on the scene. I became involved to the extent of providing a sympathetic ear in conversation with one of my friends from the laboratory in question. By all reports, the entrepreneurial programmer later became involved in some heated discussion of these points with the publicist, my research friends, and several individuals well aware of the issues involved (not including myself).

As of this writing, the matter remains unresolved. The entrepreneur still has not decided whether to change the name of his program or not, but I hope that, through the mediation of several individuals who know the facts of the matter, he will recognize the error of his ways and, in so doing, learn a bit about the in-

tellectual versus commercial realms of endeavor. I have learned that some sort of decision will probably have been made by the time you read this.

As for the publicist, he continues in his inimitable style to spin wheels of fancy.

In the intellectual marketplace of ideas, the coin of the realm is thought. He or she who owns a reputation as a result of careful thought has a purse full of golden coins ready for the bazaar of ideas. A marketplace of ideas or commerce is a human activity where all parties benefit as a part of trade. One cannot expect willing and bountiful trading when one party plays by a set of rules different and incompatible from the other's set.

The productive results of innovation and thought carry a requirement for the respect of the rules of the game. One of these rules in the intellectual world could be stated "thou shalt not take thy neighbor's reputation as thine own." When you use an idea, credit its source where appropriate, but do not pretend to imply that your version of the thought is the same.

It is perfectly fine to use an inspiration from someone's published thought in a commercial product of your own. But be sure that you make clear that the product is your own! Credit the inspiration to be sure. However, if you do not have an endorsement from the source of the inspiration, do not attempt to advertise that thought in any way as a product endorsed by the source of the inspiration.

Naturally, the ideal state is that in which the researcher is also able to capitalize directly on the results of his or her innovation. By being the first to it and the best able to understand the problem, an inestimable advantage is gained over the nonoriginal machinations of those who merely implement the published designs.

The main rewards of research must be understood for what they are: an appreciation of difficult problems and the satisfaction of seeing them through to a better understanding.

Occasionally in research a commercial gold mine is found that exudes some of its wealth on the innovator. But this is a small part of motivation for a life of ideas. The innovator's reputation is based on a mutual trust and fascination with ideas. Entrepreneurs with a long-term point of view respect this trust by avoiding any semblance of potential violation of that trust. End of commentary.

* * *

A Note

The lives of individuals are marked by a series of changes through growth. Enterprises evolve in much the same way. BYTE has gone through many such changes. It began as an idea in the minds of my associates and me five years ago. After much hard work it matured to the point where it now has a circulation in excess of 160,000 and an assured future as a member of the family of magazines published by McGraw-Hill. This issue marks the fifth anniversary of BYTE's first issue, published in September 1975.

Since BYTE has matured to the point where a founder's day-to-day input is no longer a requisite to the continued health of the venture, I am now in the fortunate position of being able to indulge in my other interests and goals. While continuing with many of the functions at BYTE that have occupied me over the last five years, I will be able to engage in consulting activities related to the technology of, and markets for, small computer systems. Such activities have always been of great interest to me. Only with the evident maturity of BYTE and the cooperation of McGraw-Hill am I now able to spend about half of my time on such ventures.

The day-to-day operations of the magazine will be in the very capable hands of my successors, Chris Morgan and the technical editors of BYTE's staff. My new relationship with BYTE is reflected in a new title on the masthead: "Founding Editor." With my continued intimate involvement with BYTE, I shall truly have the best of both worlds. . . .CH■

Circle 3 on inquiry card. →

Why not kill two birds with one stone?

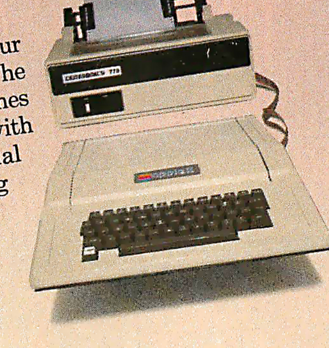
If you have an Apple* and you want to interface it with parallel and serial devices, we have a board for you that will do both. It's the AIO.™

Serial Interface.

The RS-232 standard assures maximum compatibility with a variety of serial devices. For example, with the AIO you can connect your Apple* to a video terminal to get 80 characters per line instead of 40, a modem to use time-sharing services, or a printer for hard copy. The serial interface is software programmable, features three handshaking lines, and includes a rotary switch to select from 7 standard baud rates. On-board firmware provides a powerful driver routine so you won't need to write any software to utilize the interface.



Parallel Interface.



This interface can be used to connect your Apple* to a variety of parallel printers. The programmable I/O ports have enough lines to handle two printers simultaneously with handshaking control. The users manual includes a software listing for controlling parallel printers or, if you prefer, a parallel driver routine is available in firmware as an option. And printing is only one application for this general purpose parallel interface.

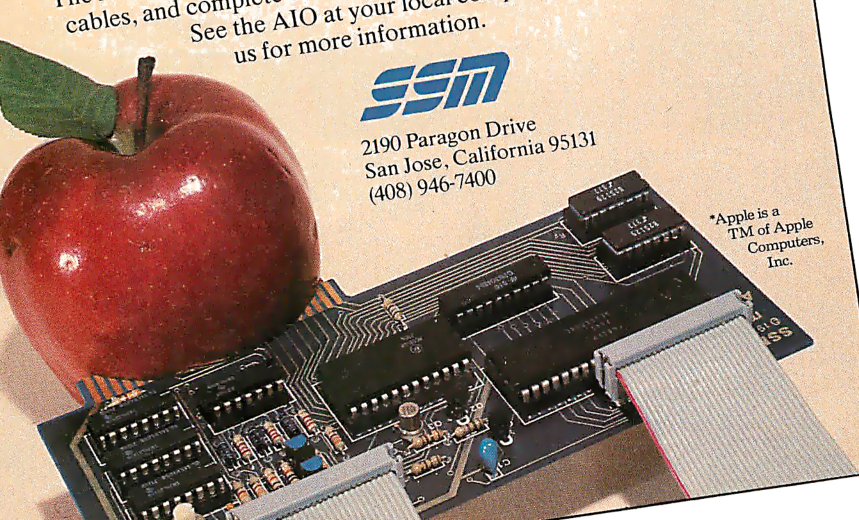
Two boards in one.

The AIO is the only board on the market that can interface the Apple to both serial and parallel devices. It can even do both at the same time. That's the kind of innovative design and solid value that's been going into SSM products since the beginning of personal computing. The AIO comes complete with serial PROM's, serial and parallel cables, and complete documentation including software listings. See the AIO at your local computer store or contact us for more information.

SSM

2190 Paragon Drive
San Jose, California 95131
(408) 946-7400

*Apple is a TM of Apple Computers, Inc.



Maybe we can save you a call.

Many people have called with the same questions about the AIO. We'll answer those and a few more here.

Q: Does the AIO have hardware handshaking?
A: Yes. The serial port accommodates 3 types—RTS, CTS, and DCD. The parallel port handles ACK, $\overline{\text{ACK}}$, BSY, STB, and $\overline{\text{STB}}$.

Q: What equipment can be used with the AIO?
A: A partial list of devices that have actually been tested with the AIO includes: IDS 440 Paper Tiger, Centronics 779, Qume Sprint 5, NEC Spinwriter, Comprint, Heathkit H14, IDS 125, IDS 225, Hazeltine 1500, Lear Siegler ADM-3, DTC 300, AJ 841.

Q: Does the AIO work with Pascal?
A: Yes. The current AIO serial firmware works great with Pascal. If you want to run the parallel port, or both the serial and parallel ports with Pascal, order our "Pascal Patcher Disk."

Q: What kind of firmware option is available for the parallel interface?
A: Two PROM's that the user installs on the AIO card in place of the Serial Firmware PROM's provide: Variable margins, Variable page length, Variable indentations, and Auto-line-feed on carriage return.

Q: How do I interface my new printer to my Apple using my AIO card?
A: Interconnection diagrams for many popular printers and other devices are contained in the AIO Manual. If your printer is not mentioned, please contact SSM's Technical Support Dept. and they will help you with the proper connections.

Q: I want to use my Apple as a dumb terminal with a modem on a timesharing service like The Source. Can I do that with the AIO?
A: Yes. A "Dumb Terminal Routine" is listed in the AIO Manual. It provides for full and half duplex, and also checks for presence of a carrier.

Q: What length cables are provided?
A: For the serial port, a 12 inch ribbon cable with a DB-25 socket on the user end is supplied. For the parallel port, a 72 inch ribbon cable with an unterminated user end is provided. Other cables are available on special volume orders.

The AIO is just one of several boards for the Apple that SSM will be introducing over the next year. We are also receptive to developing products to meet special OEM requirements. So please contact us if you have a need and there is nothing available to meet it.



SSM Microcomputer Products
2190 Paragon Drive
San Jose, California 95131
(408) 946-7400



The man, the lig

ht and the Apple.

If you could talk to Thomas Edison, he'd tell you what it was like to turn the lights on in 1879. You could tell him about some bright ideas of the 20th century... particularly, a technological phenomenon that can handle everything from solar heat control to lighting your home via voice command. The Apple personal computer.

Expand your own inventiveness with the always-expandable Apple.

Take a look inside your local computer store. There's a range of Apple systems for you... whether you want expansion capabilities of four or eight accessory slots... or memory expandable to 64K bytes or 128K bytes. With this kind of flexibility, the possibilities for creating your own computer system are endless.

Want to add an A to D conversion board? Apple makes it happen. Want to plug into time sharing, news and electronic mail services? Apple does it all. Because Apple is the most popular personal computer with the least complicated interface, over 100 companies supply peripherals for the Apple family... including an IEEE 488 bus for instant control.



With Apple, Edison could've written a program to determine why some filaments burned longer than others.

Disk drives, a tool kit and creativity in color.

Apple was one of the first to use disk drives for increased performance and application versatility. Today, our 5¼" disk drive offers high density (143K bytes), high speed and low cost. No wonder this drive is the most popular on the market.

But now Apple goes one better with the DOS Tool Kit. A series of utility programs, it gives you the freedom to easily design 280h x 192v graphic displays in a palette of living color... depending on your choice of Apple system.

Edison was first with the movie camera and projector. Now, with Apple's DOS Tool Kit, you can be first to work wonders with colorful creative animation.

Imagine the broadest line of software programs ever.

Apple's broad line of peripherals is equalled only by the most extensive line of software you'll find in the personal computing world. Since more than 170 companies offer software for the Apple family, you can have one of the most impressive program libraries ever.

When you write your own programs, your Apple speaks creatively in BASIC, Pascal, FORTRAN, PILOT and 6502 assembly language. Use these languages to score a sonata. Apple will play back your musical masterpiece on its built-in speaker.



Edison had the first movie camera... and Apple has the DOS Tool Kit that takes you into the colorful world of animation.

Edison listened to his voice on a revolutionary phonograph in the 1800s... now you can listen to the sounds of today with Apple's inventive family of personal computers.

Where to find even more illuminating Apple experiences.

There's always something new being invented at Apple to set your imagination soaring. And there's always an expert to tell you all about it in detail. Your Apple dealer. If you already own an Apple, there's a whole future ahead to challenge man, mind and machine.

If you're considering a personal computer, stop by the computer store and compare. Apple's reliability, proven performance and recognized technological leadership will help you see the light. Don't let history pass you by. Visit your nearest Apple dealer, or call 800-538-9696. In California, 800-662-9238.



Circle 4 on inquiry card.

Cromemco Lauded

After reading of the many horror stories of poor documentation and service within the microcomputer industry, I want to point out the excellent treatment I have received from Cromemco Inc.

In July, 1979, I purchased a System III with four disk drives and most of Cromemco's available software. Lately, I have added the 3102 Terminal and the 3355A Printer. I have found the documentation very complete. The manuals for the above products form a pile 10 inches high.

When I first received the System III, I had some difficulty using the third and fourth disk drives. Because I was not too familiar with the system, and the drives worked in certain situations, I concluded that the drives were probably OK, and that I did not understand some detail of the system's operation. Several weeks ago I was forced to conclude that the drives were defective, and I called Cromemco. Even though the warranty on the drives had expired six months earlier, they accepted the responsibility for the defect and had the repaired drive back to me within two weeks.

In addition, I have begun receiving updated software on disks. The software has been considerably enhanced. There is no charge for the additional features. I don't even have to pay for the disks.

Finally, though I had done a lot of programming on large systems and am quite knowledgeable about electronics, I had never worked with FORTRAN or COBOL, and initially I was not up to speed on the system aspects of microcomputers, especially the use of the disk drives. My questions were always answered courteously, even when they were naive, and my telephone calls were always returned.

The equipment is conservatively designed and well constructed. The software and operating system are capable and straightforward to use.

I have never been more pleased with all aspects of a purchase than I am with my Cromemco system.

Wil Schuemann
Sage Instruments
501 Maple St
Parkersburg WV 26101

Making Music

Hal Chamberlin's article on "Advanced Real-Time Music Synthesis Techniques" (April 1980 BYTE, page 70) was timely and informative. Since I have been experimenting with similar techniques for several years, I can vouch for the viability of his procedures, but I would also like to comment on several points raised in the article.

I agree that most digital synthesizers on the market do not have sufficient control for either education or serious musical work. A recent informal poll of musicians showed that the majority desired at least four voices, and complete control over envelope, timbre, loudness, and pitch for these purposes.

While Mr Chamberlin's technique provides for the important change of timbre with time that is so often neglected, his sequence table is stepped through at a rate determined by the tempo setting, so a voice will behave differently at slow

TRS-80* Model I Computer Owners

Store More Data on a 5″-Disk Than on an 8″-Disk

The Doubler™: Percom's new proprietary double-density adapter for the TRS-80* computer.

Plug the DOUBLER™ into the disk controller chip socket of your Expansion Interface and . . .

Store up to 354 Kbytes of formatted data on five-inch disks.†

- Increase **formatted** storage capacity of your minidiskettes from 1½ to almost 4 times.
- Use with standard 5-inch drives rated for double-density operation.
- The DOUBLER™ reads, writes and formats **either** single- or double-density disks.
- Proprietary design allows you to continue to run TRSDOS*, NEWDOS‡, Percom OS-80™ or other single-density software **without making any changes** to software or hardware.



Mini-Disk Systems
More storage capacity, higher reliability — from Percom, the industry leader. One-, two- and three-drive configurations in either 40- or 77-track format, starting at only $399.

- Includes DBLDOS,™ a **TRSDOS* compatible** double-density disk operating system.
- CONVERT utility, on DBLDOS™ minidiskette, converts files and programs from single- to double-density or double- to single-density.
- **Plug-in installation:** No strapping. No trace cutting. Restore your Expansion Interface disk controller to original configuration by simply removing the DOUBLER™ and reinstalling the original disk controller chip.

PERCOM DISCOUNT COUPON
worth $20
toward
The Purchase of a
DOUBLER™
Coupon No. B10101
Expires December 30, 1980
Void where prohibited by law.

- The DOUBLER™ circuit card includes high-performance data separator, write precompensation circuits for reliable disk read operations — even on 77-track drives.

Introductory price, including DBLDOS™ and format conversion utility on minidiskette, **only** $219.95. Use the coupon for even greater savings.

Call toll-free, 1-800-527-1592, for the address of your nearest dealer, or to order direct from Percom.

†Percom TFD-200™ drive, OS-80D™ operating system



PERCOM DATA COMPANY, INC.
211 N. KIRBY GARLAND, TEXAS 75042
(214) 272-3421

PRICES AND SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.

™ trademark of Percom Data Company, Inc.
* trademark of Tandy Radio Shack Corporation which has no relationship to Percom Data Company.
‡ trademark of Apparat Company, Inc.

and fast tempi. Most musical instruments, however, vary their amplitude (tremolo), pitch (vibrato), and timbre (we need a word for this—tambolo?!) at a rate almost independent of the score tempo, but in a manner suited to the instrument and type of music played. This could be accomplished by adding one more counter for vibrato-tremolo-tambolo update independent of the tempo counter.

The computation of signal/noise (S/N) ratios for synthesizers can be misleading. If the intent is to *reproduce* a musical sound, then a resolution of 60 to 80 dB is a necessity. However, if the intent is to *produce* music from scores, a much lower S/N ratio can be tolerated if the distortion partials are harmonic. After all, the "noise" content of flutes or harpsichords can be very high, but is considered part of the natural sound of the instrument. Eight-bit D/A (digital-to-analog) converters and 256-byte wave tables do seem adequate for music-synthesis experimentation, at least until computer memory and power become somewhat cheaper.

Mr Chamberlin's method of generating up to 8 K bytes of waveform tables is well suited to single D/A output but requires extensive dedicated storage, plus time spent in creating the wave tables. This can be markedly reduced by noting that the *ratios* of the harmonic amplitudes remain nearly constant for a considerable fraction of the note duration for many instruments. This suggests that if the envelope amplitude were provided by a separate D/A converter and its output were multiplied by a waveform multiplying D/A converter, that many fewer waveform tables would be necessary since they would contain only waveshape information, not envelope information, and they could better be reused for other voices. The additional $10 for a multiplying D/A converter would be more than offset by the savings in memory. Incidentally the envelope "volume control" must *precede* the waveform D/A converter, not follow it as implied in the text, so that the required envelope filter does not cut off the harmonics of the waveform.

Finally, there is a very serious problem with the low sampling rates (6.9 kHz to 8 kHz) mentioned in the article. Suppose that the highest fundamental desired is C_6 (≈2100 Hz) and that at least four harmonics are necessary to produce the desired timbre (both of these figures are very conservative). Then the highest frequency present in the sampled waveshape is ≈8400 Hz, and since a "headroom" of at least 10% is needed for the anti-aliasing low-pass filters, the filter stop-band edge can be no lower than ≈9300 Hz. So for these requirements, the sampling frequency must be at least 18,600 Hz by the Nyquist criterion. A lower sampling frequency will:

1) produce aliasing distortion, or
2) limit the highest fundamental to a smaller value, or
3) force you to accept fewer harmonics in the waveform (at least at higher pitches) if aliasing is to be prevented.

A solution might be to use different waveform tables with fewer harmonics for the higher pitches, but this further complicates the algorithm, requires more waveform storage, and introduces pitch breaks into a voice's timbre like that of an organ mixture stop.

The length of my comments reflects favorably on the thought-provoking nature of this article. Mr Chamberlin's work should be of great help to new experimenters in the field of music synthesis, and will, I hope, stimulate discussion on this topic.

Donald L Shirer
Director, Computer-Based Instruction Laboratory
University of Arizona
Tucson AZ 85721

Suspected Brain Malfunction Disables Op Code Equivalence

My article in the June 1980 BYTE "Z80 Op Codes for an 8080 Assembler" (page 64) contains a monumental goof, which I can only explain in terms of brain malfunctions and the like.

To define a symbol such as XAF as being equivalent to hexadecimal 08, one doesn't write "XAF DB 08H"; obviously one writes "XAF EQU 08H". Table 2 on page 70 makes sense only if you put EQU statements between the columns, not DBs and DWs as I said.

Judging from letters I have received, BYTE readers aren't dumb enough to believe everything they read, thank goodness. My intelligence seems to have gone down about 10 DB or if you like, 10 DW. Sorry, people.

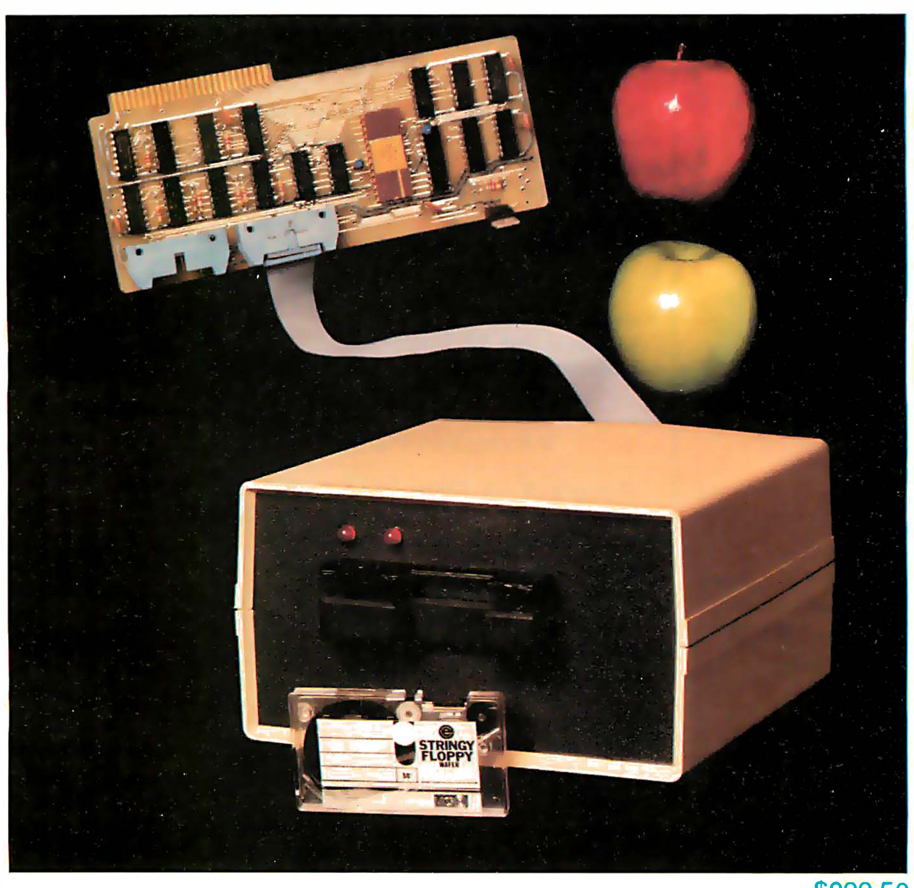
Bill Powers
1138 Whitfield Rd
Northbrook IL 60062

Z80 Op Codes...The Continuing Saga

There is an error in the article "Z80 Op Codes for an 8080 Assembler" which appeared in the June issue of BYTE. On page 64 the statement "XAF DB 08H" should read "XAF EQU 08H". As writ-

FINALLY AN ALTERNATIVE TO DISKS THE EXATRON STRINGY FLOPPY (MASS STORAGE SUBSYSTEM)

LOW COST
RELIABILITY
SPEED



$299.50

INFORMATION PACKAGES AVAILABLE NOW FOR:

APPLE	OSI	RS-232
PET	KIM/SYM/AIM	STD-BUS
TRS-80	S-100	OEM



CALL OUR HOT LINE TODAY

800-538-8559

TO REQUEST AN INFORMATION PACKAGE

EXATRON, INC. ▪ 181 COMMERCIAL STREET ▪ SUNNYVALE, CA 94086

Circle 8 on inquiry card.

ten, XAF is assigned the address to which a byte of value 8 is assembled. The actual intent is to assign XAF the value 8. The pseudo-operation EQU serves the function of an "equivalence statement."

Using mnemonic conventions such as those developed in this article, it is simpler to use Z80 code on an 8080 assembler. However, the readability of the resultant programs will be poor. I would suggest the use of macroinstructions in lieu of the DW...DB sequences. If a macroassembler is not available, then a preprocessor could be created to expand the Z80 instructions into sequences understandable to an 8080 assembler. Either way, the source code will retain readability and will probably be less error-prone.

I believe that the basic software tools make a tremendous difference to the quality of software produced. Every Z80 computer should have at least one good Z80 assembler.

Lest I seem too critical, I did enjoy this article very much.

Anthony Skjellum
1695 Shenandoah Rd
San Marino CA 91108

Information Please

Are any of my fellow BYTE readers willing to share information with me on interfacing microcomputer systems to the IBM Models 50 or 60 electronic typewriters? I would like to use my Model 60 as an output printer, and I would appreciate some advice, if any is to be had. Thanks very much.

Michael Pinneo
3757 Vienna Dr
Aptos CA 95003

Selectric Information Sought

Do any readers of BYTE know of any commercial devices that can interface a Radio Shack TRS-80 to an old model of an IBM Selectric typewriter (a Model 71)? I would also like to hear from anyone who has bought an already-interfaced Selectric from McClain and Associates or from Worldwide Electronics. Thank you.

N Vijayan
1332 Notre Dame Dr
Davis CA 95616

Performance Improvements

I have studied the article "TRS-80 Performance Evaluation by Program Timing," by James Lewis (March 1980 BYTE, page 84) with interest. I am only concerned here with the Level II BASIC program.

The largest number a figure is divisible by without becoming redundant is its square root. If we include the statement:

```
20 C=INT(SQR(A))+1
```

and change the second FOR-NEXT loop to:

```
30 FOR B=3 TO C STEP 2
```

we will find the program runs much faster. For example, in the original program 9901 goes through the inner loop roughly 4500 times. Using the modified program, the second loop is only used 50 times which is ninety times faster. I find this version will run in about 25 minutes.

Here is a listing of the modified program:

```
1    CLS:PRINT"1 2 3";
10   FOR A=5 TO 10000 STEP 2
20   C=INT(SQR(A))+1
30   FOR B=3 TO C STEP 2
40   D=A/B
50   IF INT(D)=D THEN NEXT A
60   NEXT B
70   PRINT A;
80   NEXT A
```

Brian Glover
POB 2102
Inuvik, Northwest Territories
X0E 0T0, Canada

More Improvements

Mr Lewis, in his article in the March 1980 BYTE, seems to compare two dissimilar computers. It was unclear to me what could be gained by this kind of comparison. The run time of a program is not only sensitive to the computer being used, as well as the programming language, but also to many other seemingly trivial factors.

For instance, Mr Lewis wanted to find all the prime numbers less than 10,000. His method was to divide by successive odd numbers. If division occurred without a remainder, then the number being divided is not a prime. The problem was that he kept dividing until the divisor was half of the dividend. For example, to check a number that was almost 10,000 he would keep dividing by numbers until he has used up all those less than 5000. It is easy to show that the time to stop is at the square root of the number, not half the number. He could have stopped after checking numbers up to 100 instead of 5000.

This is true because, if some number greater than 100 is divided without a remainder, the quotient would be some number less than 100 and this would have been revealed before ever reaching 100.

Mountain Hardware makes more peripherals for the Apple Computer than Anybody.

and . . . a place to put them

INTROL X-10

Intelligent Home Controller for lights and appliances. Real-time schedules and energy conservation. Complete applications software package. Home security with random scheduler. Power usage accounting package for home energy cost control. No wiring required.

APPLE CLOCK

Real-time and date information. Interrupts permit Foreground/Background operation of two programs simultaneously. Battery back-up. Crystal-controlled for ± .001% accuracy. Onboard ROM for easy access from BASICs. Supports PASCAL. Time from one millisecond to one year.

SUPERTALKER SD200

Input/Output Speech Digitizer. Permits talking programs. I/O capability allows interactive programs with speech-prompted inputs. Use output for speech directed activities in business systems, announcements in a control-room, or sound effects in entertainment programs. Easy to use because input as well as output is under user control with special software operating system.

ROMWRITER

Program your own EPROMs. Create your own firmware. Programs 2K, 2716 5V EPROMs. Disk software package provides easy EPROM programming. EPROMs are verified after BURN. RUN your programs from on-board socket or install them on ROMPLUS+.

ROMPLUS+

More power for your system through firmware. Six sockets accept 2716 EPROMs or ROM equivalents. Six or any combination can be used at once. Scratch-pad RAM and two TTL connectors. Special 2K ROMs available for powerful system enhancement: Keyboard Filter ROM—COPYROM—Others coming soon.

MusicSystem

Sophistication previously available only on experimental mini and mainframe computer synthesizers. Digital instrumental music synthesizer system. 16 voices in stereo. Instrument definitions simulate the sound of real instruments—and more. Fully programmable waveforms. Envelope Control. Composition system—sheet music input using standard music notation. Chords and multi-part scoring up to 16 voices. A true instrument that anyone with an Apple can play.

A/D+D/A

16 channels analog to digital input. 16 channels digital to analog output. Eight bit resolution. Super-fast 8μ sec. conversion time. Monitor and output to the real world. All on one card.



EXPANSION CHASSIS

By popular demand! Eight more slots for your Apple. Attractive sturdy enclosure. Its own heavy duty power supply. Easy to use. Address cards in Expansion Chassis the same way as in your Apple. Only one additional command to specify in Apple or in Expansion Chassis. Compatible with all Apple peripherals.

MOUNTAIN HARDWARE has the most comprehensive line of Apple peripherals available. Anywere. From anybody. We know the Apple inside and out and are committed to providing the most innovative and unique products to expand and enhance its capabilities and use. After all, we were the first company to make an Apple peripheral—except Apple Computer.

The message is simple. If you have an Apple, you need to know MOUNTAIN HARDWARE.

Available at Apple Dealers worldwide.

Mountain Hardware
Leadership in Computer Peripherals
A Division of Mountain Computer, Inc.
300 Harvey West Blvd.
Santa Cruz, CA 95060 (408) 429-8600

MORE PERIPHERALS? Send me information.

NAME ______________________

ADDRESS ______________________

CITY __________ STATE __________ ZIP ______

I wrote the following short program, PRIME, and ran it on my North Star computer in about 24 minutes:

```
10 REM PRIME
20 FOR K=5 TO 10000 STEP 2
30   I=3
40   IF INT(K/I) = K/I THEN 80
50   I=I+2
60   IF I ↑ 2< =K THEN 40
70   !K
80 NEXT
90 END
```

Division for a conventional microcomputer for which double precision is necessary is slow, and the fewer occurrences in a program the quicker the program will run. When I eliminated one division in my program to produce PRIME 2, the running time was reduced to 17 minutes:

```
10 REM PRIME 2
20 FOR K=5 TO 10000 STEP 2
30   I=3
40   X=K/I
50   IF INT(X)=X THEN 90
60   I=I+2
70   IF I ↑ 2< =K THEN 40
80   !K
90 NEXT
100 END
```

But the most important consideration is how the translator works; an interpreter is devilishly slow. A computer will run considerably faster because machine code is actually executed. I wrote a short Pascal program for my North Star, *primes*, and was surprised to find that it executed in 1 minute and 46 seconds. (See listing 1.)

Mr Lewis' results for the large IBM computer was 1 minute and 19 seconds using a PL/I compiler. Does this mean that my microcomputer is almost equivalent to this huge IBM machine? I think not.

Comparisons of this sort do not prove much; they just show how many variables are involved in determining the time it takes to run a program!

Ivan Flores
Flores Associates Computer Consultants
108 8th Ave
Brooklyn NY 11215

Comparisons of this sort may not prove much, but you (and many other readers) found the idea interesting enough to experiment with. Evaluation of performance encourages programmers and designers to work their crafts with efficiency, and to search for the elegantly simple solutions that improve .... **CPF**

Listing 1

```
program primes; {writes out a number of primes}
var i,j,k, n : integer;
begin
  k := 2;
  while k < = 5000 do begin
      n := 2*k + 1;
      j: = 1; i := 3;
      while (i * i < = n) and (j = 1) do
        begin
        if n mod i = 0 then j: =0 else   i: =i+2;
      end;
      if j=1 then write(n, ' ');
      k := k + 1;
     end;
end.
```

Pascal Precision

The letter from Martin Berman concerning numerical precision in UCSD Pascal (BYTE, June 1980, page 17) struck one of my current concerns. The actual precision available in UCSD Pascal is 7.2 decimal digits; ie: the data type *real* will accommodate integer values as large as 16,777,216 (2^{24}) exactly. However, the output routine is limited to six significant digits. To print the remaining available 1.2 digits will require either a revision to the system-output routine or an output routine custom-made for the application.

I am not privy to the design process at UCSD, but suspect that this is an attempt to "protect" the user from round-off error. I, for one, deplore such attempts at protection since the user who actually knows what he is doing is forced to "program around" the system. A reasonable precaution is to give no more precision than the system has (eight digits in the case of UCSD Pascal), although even this is open to question—a fellow programmer was once caught by this type of "protection" even though he was using only powers of two which are exactly represented throughout the range of the system.

Incidentally, there is a routine available for determining the actual precision of floating-point routines. It may be found in *Pascal News*, number 13 (December 1978). I enclose a copy of the code as I ran it on my UCSD Pascal system, along with the output it generated.

We see the S-100 a little differently.

We mass-produce S-100 products to deliver industrial quality, at industrial prices.

You systems builders who need top quality, full featured, *workhorse* S-100 building blocks at the most competitive prices now have a source. California Computer Systems.

Industrial quality means top grade materials, components, and assembly, plus complete testing for absolute reliability.

Industrial quality means solid designs, a full complement of the important features you require, and a product line that delivers performance.

Industrial pricing comes from mass production. We buy at the right prices, and build *in quantity*, using state-of-the-art facilities and techniques. Including complete burn-in, for full performance right off the shelf.

Our industrial point of view means you get higher performance, greater reliability, and lower prices. If these are features you would like to see in your S-100 system, see things our way.

Because for serious users with serious uses for the S-100, these are the industrial standards.



California Computer Systems
250 Caribbean Sunnyvale, CA 94086 (408) 734-5811

Listing 1

```
program representation;

var base, numberofdigits, i      : integer;
    rounding                     : boolean;
    epsilon                      : real;

procedure enquiry (var radix, digits : integer;
                   var rounds : boolean);
  var number, increment          : real;
begin
        (*find large integral value just beyond integer limits*)
  number :=2;
  while (((number+1)-number) = 1) do
   number := number * 2;
  (*end while*)
        (*manufacture the next largest real value*)
  increment := 2;
  while ((number+increment) = number) do
   increment := increment * 2;
  (*end while*)
        (*subtract these to give radix of representation*)
  radix := trunc((number+increment)-number);
        (*see if it rounds or truncates by adding (radix-1)*)
  rounds := ((number+(radix-1)) NEQ number);
        (*work out how many digits in mantissa*)
  digits := 0;
  number := 1;
  while (((number+1)-number) = 1) do begin
   digits := digits +1;
   number := number * radix;
  end; (*while*)
end; (*enquiry*)

begin
        (*find out basic properties*)
  enquiry(base,numberofdigits,rounding);
  writeln(' Base = ',base);
  writeln(' Number of digits = ',numberofdigits);
  if rounding then
   writeln(' Rounded')
  else
   writeln(' Truncated');
  (*end if*)
        (*compare the precision bounds*)
  epsilon := 1;
  for i := 1 to numberofdigits do
   epsilon := epsilon/base;
  (*end for*)
  if rounding then epsilon := epsilon/base;
        (*print the best and worst precision*)
  writeln(' Best and worst precisions are ',
           epsilon,(epsilon*base));
end.
```

My hard-copy terminal does not have greater-than or less-than symbols. Thus "NEQ" is inserted for the Pascal "not equal" symbol.

Base = 2
Number of digits = 24
Rounded
Best and worst precisions are
  2.98023E−8 5.96046E−8

Fred Crary
7750 31st Ave NE
Seattle WA 98115

May We Suggest a Gasp Mask?

Philip K Hooper is not alone. I too noticed the foul odor of the magazine. (See Letters, April 1980 BYTE, page 16.) Not only do I love computer science, but I love my body, and my health is paramount. I therefore abstain from the inhalation of foul vapors and fumes.

A Healthy Minority
Jon Dattorro
1379 Kingstown Rd Apt 1A
Kingston RI 02881

*I am told that our printer used an improper glue to bind the pages together, causing the unusual smell. The printer has promised to henceforth use a different glue, and we expect that the odor problem will not recur....*RSS ■

When It Comes To Add-on Memory...

LOBO Has It All.

LOBO DRIVES manufactures a full line of S-100 computer compatible disk drives. All drives are software compatible with most S-100 disk operating systems and applications software programs. Only LOBO DRIVES offers you the variety and choice of floppy and fixed disk drives. Choose from 5¼ and 8-inch floppies, 5¼ and 8-inch Winchester technology fixed disk drives, and several Floppy/Fixed disk combinations. Each LOBO DRIVES system is thoroughly tested and burned-in and has the famous LOBO DRIVES One Year, 100% Parts/Labor Warranty.



MODEL 400 5¼-INCH FLOPPY DISK MEMORY SYSTEM

A high-speed (298) Msec Access), high-reliability (8000 hrs MTBF), low-cost floppy disk memory system. It is available in both soft and hard sector formats, and a choice of single or double density configurations.

- Up to 220 KBytes Capacity
- Single/Double Density
- Soft Sector Format
- Complete Software Compatibility

MODEL 800/850 DUAL FLOPPY DISK DRIVE MEMORY SYSTEM

LOBO DRIVES offers you a choice of single-sided, single or double density (Model 800) or double-sided, single or double density (Model 850) dual 8-inch memory subsystems. Each system comes complete with chassis and power supply, cables, controller and interface.

- Compatible with Most S-100 DOS Systems
- Up to 3.2 MByte Capacity

MODEL 1850 DUAL FLOPPY/FIXED DISK MEMORY SYSTEM

No more worries about back-up. LOBO DRIVES has combined the latest state-of-the-art Winchester technology with the proven reliability and dependability of its Model 850 8-inch floppy disk drive to bring you the ultimate in memory expansion for your S-100 computer. The Model 1850 is the ideal memory system for small business and word processing applications.

- 5 or 10 MByte Fixed Disk Capacity
- 1.6 MByte Floppy Disk Capacity
- Software Compatibility
- Sealed Environment
- Winchester Reliability
- 70 Msec Average Access Time

MODEL 950 DUAL FLOPPY/FIXED DISK MEMORY SYSTEM

All the advantages of Winchester technology fixed disk memory: large capacity (6.38 MBytes), high speed (170 Msec avg. access time), and extended reliability, combined with the convenience of a built-in floppy disk back-up in one cabinet. Only LOBO can bring you the storage capacity of 16 mini-floppies at a fraction of the price.

- The Storage Capacity of 16 Mini-Floppies
- Built-in Back-up
- 170 Msec Access (Avg)
- Software Compatibility

See your nearest dealer, call, or write for the complete LOBO DRIVES story... find out just how competitively priced a quality drive can be.



935 Camino Del Sur
Goleta, California 93017
(805) 685-4546
Telex: 658 482



ATARI: PERSONAL COMPUTER

START WITH A BETTER COMPUTER.
Atari personal computers have built-in capabilities you can't even add on to many other personal computers. Three programming formats (slip-in ROM cartridges, disk and cassette). A 57-key upper/lower case ASCII keyboard with 29 keystroke graphics. 128 colors and hues. Four separate sound channels and a built-in speaker. Four game and graphics controller ports. A built-in RF modulator. FCC approval for connection to any TV. Plus, nationwide Atari Authorized Service Centers. And more.

ADD MEMORY.
The ATARI 800™ comes with 16K of memory. Expand up to a full 48K of memory with 8K or 16K RAM Memory Modules™ you install yourself. In less than a minute. The ATARI 400™ is supplied with 8K of RAM which can be expanded to 16K at Authorized Service Centers. Both models may be expanded to 26K of ROM with slip-in ROM cartridge programs.

ADD PERIPHERALS.
Atari peripherals are specifically designed to complement your system. Add the ATARI 410™ Audio-digital Program Recorder. Add disk drives (single or dual double-density*). The ATARI 800 individually accesses up to four drives. Add the ATARI 850™ RS232 Interface Module. Add high-speed 40 or 80-column dot-matrix printers, or, a 40-column thermal printer. Add an acoustic modem for remote data access. Add a light pen.* And there are more Atari peripherals on the way.

ADD PROGRAMS.
Atari's rapidly expanding software library includes some of the most useful, enlightening and entertaining programs available. (Some programs may require more than 16K RAM.)

- **Personal Finance and Record Keeping.** Sophisticated investment analysis programs, including bond analysis, stock analysis, stock charting and mortgage and loan analysis.

*Available Fall, 1980

Circle 14 on inquiry card.



SYSTEMS THAT GROW WITH YOU

- **Personal Interest and Development.** Conversational languages.* Music composition. Touch typing. Biorhythm. And more.
- **Professional Applications.** Graphics, statistics and programmable calculator programs. Plus VisiCalc,† the "what if" problem solving program.
- **Education.** ATARI Talk & Teach™ programs offer instruction from primary through college level. Plus, instructive games for all ages.
- **Information & Communication.** Turn your Atari into an interactive terminal. Access stock quotations, news services and other useful data banks. Transmit and receive data over regular phone lines. And more.
- **Entertainment.** Colorful, exciting programs include Star Raiders,™ Chess, Blackjack...and many more.

†Trademark: Personal Software, Inc.

- **Programming Languages.** An ATARI BASIC cartridge is included. An Assembler/Editor Cartridge is available for the advanced programmer. PILOT, extended BASIC and Pascal will be available in 1981.
- **Small Business Accounting.** General Ledger. Accounts Receivable. Accounts Payable. Inventory Control. Order Entry.

ADD IT UP FOR YOURSELF.

Compare the Atari to any personal computer in its price range. Compare built-in features. Compare expandability. Compare peripherals and accessories. Compare programming and formats (ROM cartridge, disk or cassette). And if you run a business, ask your Atari retailer about the Atari Accountant,™ the complete, computerized accounting system for small businesses. At Atari we're building computer systems you won't outgrow.

ATARI®

PERSONAL COMPUTERS

1265 Borregas Avenue, Sunnyvale, CA 94086
Call toll-free (800) 538-8547 (Except Alaska and Hawaii)
(In California: (800) 672-1404) for the name of your nearest Atari retailer.

Build a Low-Cost, Remote Data-Entry Terminal

Steve Ciarcia
POB 582
Glastonbury CT 06033

Remote data-entry terminals are not something new. They are devices which provide a means of direct, specialized communication with a computer. In July's Circuit Cellar I said that a pushbutton switch on the end of a long cable is probably the least expensive and most secure form of remote data entry. This is still true, but now it is time to look at more sophisticated forms of remote data entry.

There is no formal definition of what constitutes a remote data-entry terminal. The application defines the classification. While a regular video-display terminal can be used for data entry, remote data-entry terminals are usually specially fabricated to fit the application and environment. Remote data-entry terminals almost always communicate in duplex mode, and are capable of displaying computer directives to the operator as well as sending operator input to the computer.

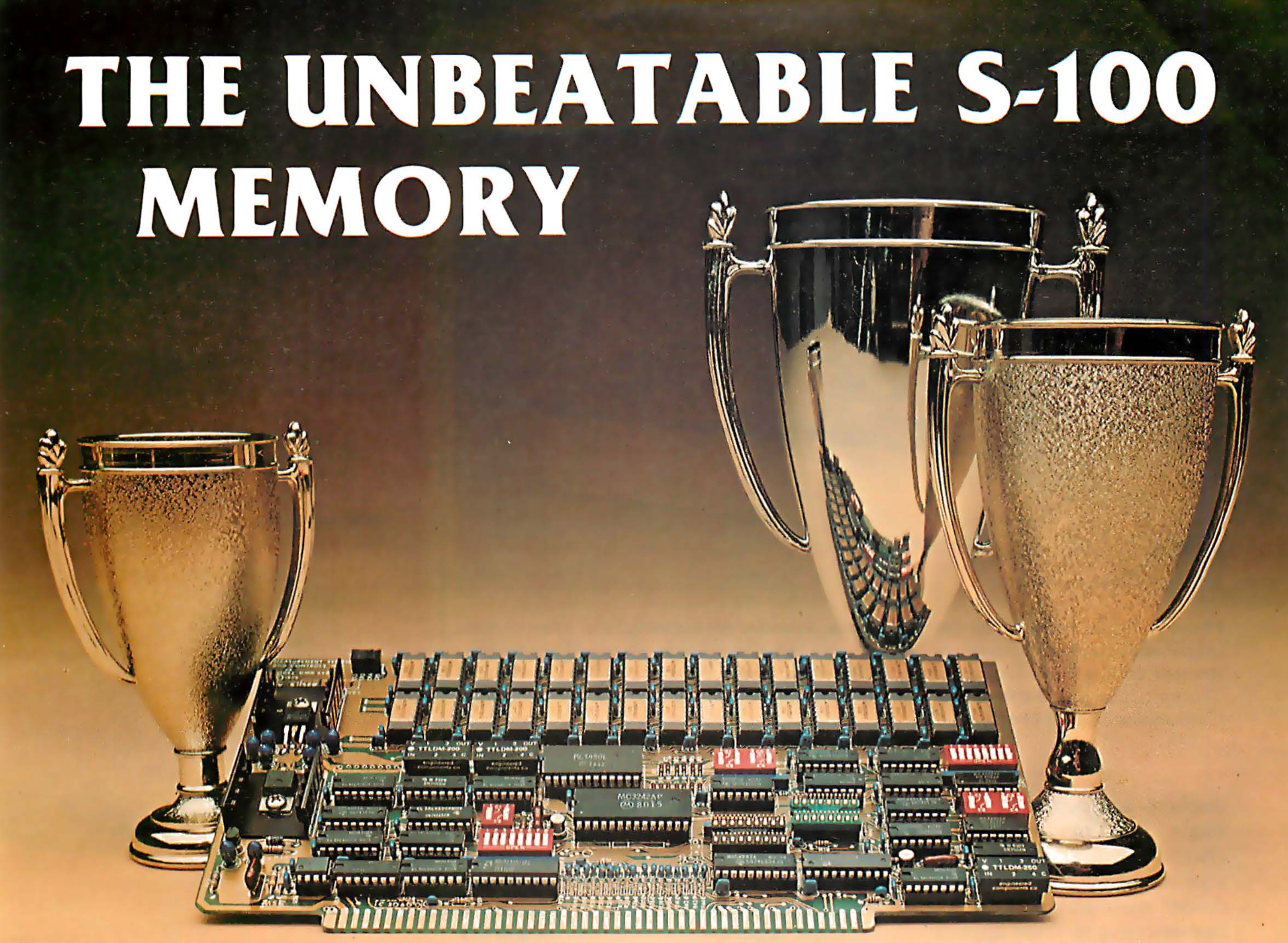
A further refinement is that the buttons on the panel frequently have function/numeric nomenclature rather than the character set we normally associate with keyboards. A key bearing the label "START" may in fact transmit an ASCII (American Standard Code for Information Interchange) "A" when pressed. Application software running on the control computer is used to recognize that a letter "A" means "initiate the process." The transmission length and protocol should be preset to reduce operator error and entry-panel complexity.

Remote data-entry terminals are usually specially fabricated to fit the application and the environment.

For example, an entry terminal associated with a dip-plating line in a factory would probably have a panel with a numeric keypad and function buttons labeled "Bath 1", "Bath 2", "Anode Current", "Voltage", "Time", and "Temperature". If the operator has to set the anode current in the plating tank, he presses the "Anode Current" button and then enters a four-digit value on the numeric keypad. When the control computer detects the anode-current function button being pressed, it reads the next four characters as numeric information pertaining to the anode-current function. Other function keys could have entirely different entry sequences.

To minimize error, most industrial data-entry terminals rely on considerable handshaking. At the very least, they include an accept/reject indicator for the operator. If the numeric portion of the anode-current entry did not fit within the limits prescribed for the process, a reject signal must be given to the operator so the data can be reentered.

In the more sophisticated units, the data-entry panel often incorporates an alphanumeric display. Usually, it is unnecessary to display textual material to the operator, and these



That's the MEASUREMENT systems & controls DMB Series of S-100 bus memory modules, fully compatible with **ALPHA MICRO, CROMEMCO, NORTH STAR, MP/M**, and most other S-100 systems.

Definitely a winner, the DMB Series is available with Bank Select (DMB6400) or without (DM6400) and utilizes industrial quality construction, provides outstanding reliability, and is backed by dedicated customer service and a one year guarantee.

The DMB6400 uses I/O port addressing for the bank select feature. A switch provides the ability to select any one of the 256 I/O ports for addressing the memory banks. The memory is configured as four totally independent 16K software selectable banks, with each bank addressable on any 16K boundary.

Outstanding features such as those listed below make the DMB series the UNBEATABLE S-100 Memory.

- Four independent 16K software selectable banks.
- Each bank is independently addressable on any 16K boundary.
- Switch selectable bank sizes — from 16K to 64K in 16K increments.
- Eight banks (512K) per I/O port for each of the 256 ports.
- Z-80 4MHz operation with no wait states using transparent refresh.
- On-board diagnostic LED's.
- Low power — 8 watts maximum.
- Reliable, tested and burned-in memory.
- IEEE S-100 compatible timing.
- One year guarantee.
- Attractive Dealer & OEM Prices.

See your nearest computer dealer, or contact us for the complete story on the UNBEATABLE S-100 Memory.

Systems Group

A Division of MEASUREMENT systems & controls incorporated

867 North Main St. / Orange, Calif. 92668 / (714) 633-4460
TWX/TELEX: 678 401 TAB IRIN



Photo 1: *Deluxe remote data-entry terminals, intended for industrial use, often contain specialized equipment to read card-badges, or control unusual functions. Many are constructed with a hazardous environment in mind, and are waterproof or blast-proof. This particular unit is a function/numeric panel (FNP) manufactured by General Digital Corporation in East Hartford CT.*

displays are generally limited to a single line of sixteen to eighty characters. Gas-plasma displays or alphanumeric LED (light-emitting diode) matrices work well and are cost-effective in these applications.

Since the panel can communicate in both directions, it is possible for the operator to interrogate the process data base in the computer for specific information. Pressing the "Bath 1" and "Temperature" buttons could result in the appearance of "#1 TEMP =192 C" on the sixteen-character display for example.

The entire remote data-entry terminal can be constructed with only two integrated circuits.

Entry Panels for Personal Computers

Deluxe industrial data-entry terminals include numeric keypads, function buttons, badge readers for operator identification, Hollerith-card readers for part identification, alphanumeric displays, and elaborate self-test features. A typical unit is shown in photo 1. They can be made waterproof, blast-proof, and idiot-proof as required by the application. These are hardly attributes that suggest their use in the home. However, the concept of remote data-entry panels connected to a personal computer is not as alien as it once seemed.

In the past few months I have been presenting articles on various aspects of home control. If you have attached any control devices to your computer and have it controlling the lights and appliances around your home, you undoubtedly are using a program which manipulates logic outputs based on time, status of input sensors, and operator commands. What you have is in fact a practical, even if rudimentary, process-control system. It has fundamental similarities to the dip-plating system previously discussed.

There seems to be considerable interest in home control these days. Many new systems and peripheral devices have been introduced to meet the demand. In my opinion, however, they address only half the problem. They all seem to be limited to central-system use with no facility for remote data entry or effective *human engineering*.

The handheld remote-control devices I detailed in my July article

LOOK TO  FOR THE . . . BIG+

EXPANDABLE + DYNAMIC MEMORY (16K to 64K)



+ Works with the following Z-80 CPU Boards: Cromemco Systems, S.D. Systems, SSM (CB2A), Jade (Big Z), Q.T. (Z+80) and many others + Uses 3242 Refresh Chip with delay line + Four layer PC Board insures a quiet board + Supports 16K, 32K, 48K or 64K of memory + 24 Address lines per IEEE specifications + Optional M1 Wait state allows error-free operation with faster processors + Optional PHANTOM disable + Uses Z-80 Refresh signal + Bank on/off signal selected by I/O port 40 (Hex) per industry standard. + Bank in use determined by convenient DIP switch selection of data bus bits. + Low power consumption – 5 watts. + Convenient LED indication of bank in use

Typical access time of board – (1) using (4116-200ns) (4Mhz) 240ns
– (2) using (4116-150ns) (6Mhz) 200ns

Bare Board	$ 50.00
16K Kit	$280.00
16K A&T	$325.00
32K Kit	$360.00
32K A&T	$420.00
48K Kit	$440.00
48K A&T	$500.00
64K Kit	$510.00
64K A&T	$570.00

STOCK

Z+80 CPU REV II



+ 1K Ram On Board + 2 Programmable Timers + Power On Jump to On-Board 1K, 2K or 4K EPROM (2708-2716-2732) Can be Addressed on any 1K or 2K boundary + Parallel I/O Port + Programmable Baud Rate Selection (110 to 9600) + On-Board EPROM May be Used in Shadow Mode, Allowing Full 64K RAM to be Used + On-Board USART for Synchronous or Asynchronous RS-232 Operation (Serial I/O Port)

Bare Board	$ 45.00
Kit	$190.00
A&T	$280.00
1K Memory Kit	$ 12.00

AVAILABLE SEPTEMBER

CLOCK CALENDAR +

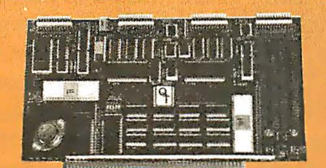


+ Time of Day in Hours, Minutes and Seconds + 24 Hour Time Format + Month and Day Date Function + Simple Read Instructions Allow Simple Interface to Basic, CPM, Etc. + Will Run With 4MHZ Processors + Can be Located at any Group of 4 I/O Port Addressed + On Board Battery Back-up

Bare Board	$ 45.00
Kit	$100.00
A&T	$150.00

STOCK

I/O +



+ Two Independent SYNC/ASYNC Serial Ports + One Strobed Eight Bit Parallel Input Port With Handshaking + Three Eight Bit Parallel Ports (Undedicated, User Configured) + Three Independent Sixteen Bit Timers + Eight Level Priority interrupt Controller + Large Prototyping area has regulated +5VDC, +12VDC, –12VDC + Two software programmable baud rate generators with crystal controlled frequencies (±.01%)

Bare Board	$ 69.00
Kit	$275.00
A&T	$375.00

STOCK

SILENCE + MOTHER BOARDS



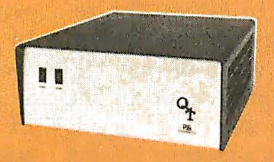
+ No Need for Termination + Very High Crosstalk Rejection + LED Power Indicator + Fits in Most Mainframes + 6, 12 and 18 Slots Available + Has Operated to 14 MHZ Quietly

	6-SLOT		12-SLOT		18-SLOT
Bare Board	$24.95	Bare Board	$29.95	Bare Board	$ 49.95
Kit	$39.95	Kit	$69.95	Kit	$ 99.95
A&T	$49.95	A&T	$89.95	A&T	$139.95

STOCK

QT MAINFRAME +

MF +



Includes cabinet, 30 amp power supply, and the IEEE S-100 motherboard (12 or 18-slot). The QT MF+ is fan-cooled, has AC line filter to eliminate EMI, and is fully-assembled and factory-tested. Power and reset switches are located on front panel.

MF+12 $450.00 MF+18 $500.00
MF+ Without Mother Board $350.00

STOCK

MF + MD

(Accepts 2 each 5¼" Disk Drives)



Includes cabinet, 18 amp power supply, IEEE S-100 Motherboard (6-12-slot) and dual-mini-disk provision with disk drive power supply. The QT MF+MD is fan-cooled, has AC line filter to eliminate EMI, and is fully-assembled and factory-tested. Power and reset switches are located on the front panel.

MF+MD12 $500.00 MF+MD6 $450.00
MF+MD Without Mother Board $450.00

STOCK

QT SYSTEM +



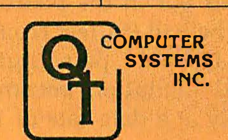
+ Main frame W/P.S. and fan + Televideo #920B Terminal + CPU – Z80 – 4MHZ + 2-8" Disk Drives (801R Shugart) + Floppy Disk Controller (Double Density) + Dynamic Memory (48K – Expandable to 64K) + 2K Monitor Program and Disk Bios on 2716 EPROM + RAM/ROM/PROM, up to 8 K in any combination on CPU + Hard Disk Compatible + 2 Serial/2 Parallel Ports + Real Time Clock + EPROM Programmer + CPM, 2.2 or 1.4 Operating System + MPM Compatible + Full line of business software available

SYSTEM+SS $4500.00 (DBL DEN SINGLE SIDED)
SYSTEM+DS $5500.00 (DBL DEN DUAL SIDED)

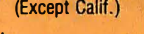
STOCK

QT TECHNICAL HOTLINE (213) 973-2619

WARRANTY – 1 YEAR AGAINST DEFECTS IN MATERIAL AND WORKMANSHIP FROM DATE OF SHIPMENT ON ALL QT PRODUCTS



15335 South Hawthorne Boulevard
Lawndale, California 90260
(213) 970-0952,
800/421-5150 (Continental U.S. Only)
(Except Calif.)



Dealer Inquiries Invited







Photo 2: *The remote data-entry terminal. Using a new serial keyboard-interface integrated circuit, construction is simple and inexpensive.*

were only one part of the solution. They facilitate operator feedback, to a limited degree, but like any transmit-only wireless device, they cannot be relied upon in critical applications. Consistent success in control can be obtained only with closed-loop communications hard-wired directly between the operator and the control computer. If you press a button on the entry panel, the computer signifies acceptance of the command by flashing an LED or displaying "HEY, GOOD BUDDY."

The easiest way to satisfy the requirements of direct communication is to use a standard video-display terminal at each remote location. The environment in the average home is not as hazardous as a factory plating line. With video terminals at $700 each, it is at least worth thinking about.

Limitations of Video Terminals

However, one problem is that most video-display terminals have an RS-232C serial output which is not supposed to be used for communication line lengths over 50 feet. Before you throw out the terminal you were saving to put in the bedroom at the end of the hall (51 feet from the computer), I should point out that this specified limitation becomes significant only at a data rate of 19,200 bps (bits per second). At 300 bps, the problem is of less concern. I have personally driven 1000 feet of transmission line at 300 bps through an RS-232C port. This is a little unorthodox so don't tell anyone I told you.

There are many computer owners like me who don't particularly care to put a $700 terminal in the garage. If your garage is anything like mine, you'd either have to keep it wrapped in plastic or periodically wipe the oil off, and dump the leaves and the dirt out of it. The average open-chassis video terminal would last about a week. Terminals specifically designed for these extremes would be very expensive and probably come in NEMA 4 or NEMA 10 (National Electrical Manufacturers Association specifications) oil- and water-tight enclosures.

Build a Low-Cost Data-Entry Terminal

The personal computer applications which would warrant using a $5000 submersible data-entry panel are limited in number. I prefer instead to build something that is less expensive. A remote-entry panel, in the garage for instance, might only require functions such as lights on and off, alarm on and off, and maybe a few heating-system functions. A unit installed in the bedroom might have a couple additional functions.

For my own use, I felt I could be satisfied with a combination of ten numeric digit codes (0 thru 9) and ten function inputs. Control-system response could be handled adequately with an 8-bit display. Proper choice of components used in construction (with regard to temperature and voltage ranges, etc) would allow use of the panel in a slightly heated garage as well as the bedroom, and make it inexpensive enough to almost be considered disposable.

Thanks to a new serial keyboard-interface integrated circuit from National Semiconductor, the entire remote data-entry terminal, shown in photo 2, can be constructed with only two integrated circuits. The entry panel, which communicates with the host computer in standard 1200 bps serial format, can be placed as far away as 2 miles from the control computer with the addition of a line driver and receiver. With the exception of the hexadecimal display shown on the prototype, the entire

26 MEGABYTES
$4995.

DRIVE A HARD BARGAIN!

Suddenly, S-100 microcomputer systems can easily handle 100 million bytes. Because Morrow Designs™ now offers the first 26 megabyte hard disk memory for S-100 systems—the DISCUS M26™ Hard Disk System.

It has 26 megabytes of useable memory (29 megabytes unformatted). And it's expandable to 104 megabytes.

The DISCUS M26™ system is delivered complete—a 26 megabyte hard disk drive, controller, cables and operating system—for just $4995. Up to three additional drives can be added, $4495 apiece.

The DISCUS M26™ system features the Shugart SA4008 Winchester-type sealed media hard disk drive, in a handsome metal cabinet with fan and power supply.

The single-board S-100 controller incorporates intelligence to supervise all data transfers, communicating with the CPU via three I/O ports (command, status, and data). The controller has the ability to generate interrupts at the completion of each command to increase system throughput. There is a 512 byte sector buffer on-board. And each sector can be individually write-protected for data base security.

The operating system furnished with DISCUS M26™ systems is the widely accepted CP/M* 2.0.

See the biggest, most cost-efficient memory ever introduced for S-100 systems, now at your local computer shop. If unavailable locally, write Morrow Designs,™ 5221 Central Avenue, Richmond, CA 94804. Or call (415) 524-2101, weekdays 10-5 Pacific Time.

*CP/M is a trademark of Digital Research.



MORROW DESIGNS™
Thinker Toys™

terminal can be built for under $50.

The heart of my entry panel is the MM57499 serial keyboard-encoder circuit. This device bears some similarity to other scanning keyboard-encoder read-only memories sold by many manufacturers. It scans a 12 by 8 key matrix and produces the ASCII code for each key. However, using an inexpensive color-burst (3.579 MHz) crystal and an internal data-rate generator, it transmits the characters serially at 1200 bps. In addition, it has the capability to receive serial data (1200 bps) as well. This information can be displayed 1 byte at a time using a single 8-bit shift register. The communications protocol in either case is fixed at 1 start bit, 8 data bits, 1 stop bit, and no parity bit. The data rate can be changed by selecting a different crystal or injecting a TTL (transistor-transistor logic)-level clock signal into pin 2 of the MM57499.

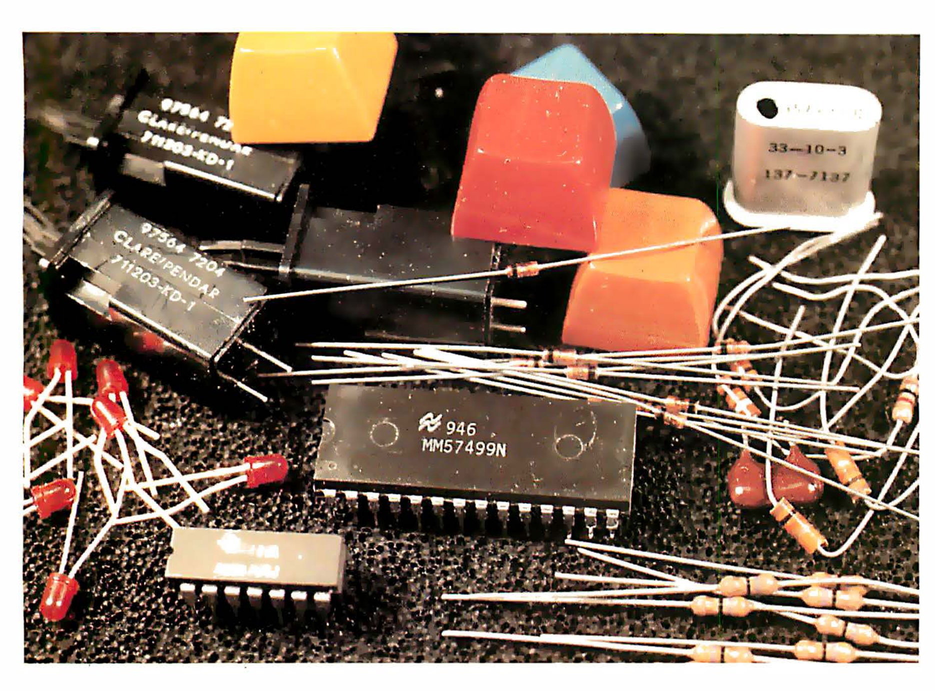


Photo 3: *It is amazing what can be done with so few parts. Most of the components shown here are quite common and easily available. The use of such materials as a color-burst crystal and a standard hexadecimal keypad make this project reliable and nearly bulletproof.*

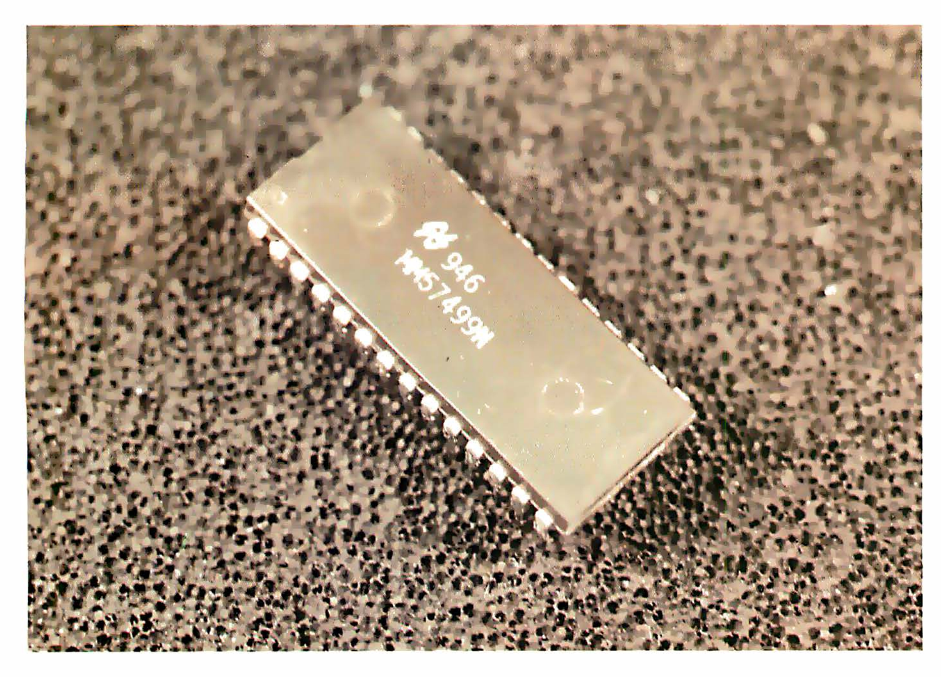


Photo 4: *This twenty-eight-pin integrated circuit keeps things simple by performing the keyboard encoding and transmitting resulting data serially. It also takes care of display functions, with the addition, in figure 2a, of a single shift register.*

A block diagram of the interface is shown in figure 1, and the schematic diagram is illustrated in figure 2. The keyboard I used is a standard twenty-key hexadecimal pad. The keys are individually connected across the X and Y matrix inputs as shown. When the A key is pressed, it will short Y_8 and X_1 together sending out the ASCII code for lowercase "a". Pressing the shift key and the A key together will send an uppercase "A". The ten letters A thru E and a thru e constitute our primary function keys. The numeric-digit keys 0 thru 9 are wired into the matrix in a similar manner. Pressing the shift key and a digit can provide ten more ASCII symbols as function indicators if needed. The key codes corresponding to the cross points of the matrix are outlined in figure 3. To change a particular key, simply determine which scan and strobe lines produce the desired code and wire the key between those points.

Three keys, F, H, and L in my unit, are given operations that are different from what their nomenclature might indicate. The F key is wired as a semicolon ";", the L key is wired as a Control "CTL" key and, the H key is now an Escape "ESC". These three keys facilitate using the programmable phrase feature of the MM57499.

During normal use, pressing the A key will send an "a". This could be interpreted by the host computer as the set-alarm signal to the home security system. To reduce potential problems, a numeric code or password could be required with all entries. Fortunately, frequent transmission of a lengthy password is not a problem.

The MM57499 contains a fourteen-character programmable memory. Pressing a Control-Escape enables this function and automatically transmits a hexadecimal FA to tell the control computer that the panel is in the program mode. The next one to fourteen keystrokes (character or control) will be stored in memory. To halt the entry process, for instance after entering a password of "abAB", we just type a Control-semicolon. This will transmit the stored message

COMPUSTAR™

INTERTEC'S NEW $2500 MULTI-USER SMALL BUSINESS COMPUTER

At last, there's a multi-user microcomputer system designed and built the way it should be. The CompuStar™. Our new, low-cost "shared-disk" multi-user system with mainframe performance.

Unlike any other system, our new CompuStar offers what we believe to be the most practical approach to almost any multi-user application. Data entry. Distributed processing. Small business. Scientific. Whatever! And never before has such powerful performance been available at such modest cost. Here's how we did it . . .

The system architecture of the CompuStar is based on four types of video display terminals, each of which can be connected into an auxiliary hard disk storage system. Up to 255 terminals can be connected into a single network! Each terminal (called a Video Processing Unit) contains its own microprocessor and 64K of dynamic RAM. The result? Lightning fast program execution! Even when all users are on-line performing different tasks! A special "multiplexor" in the CompuStar Disk Storage System ties all external users together to "share" the system's disk resources. So, no single user ever need wait on another. An exciting concept . . . with some awesome application possibilities!

CompuStar™ user stations can be configured in almost as many ways as you can imagine. The wide variety of terminals offered gives you the flexibility and versatility you've always wanted (but never had) in a multi-user system. The CompuStar Model 10 is a programmable, intelligent terminal with 64K of RAM. It's a real workhorse if your requirement is a data entry or inquiry/response application. And if your terminal needs are more sophisticated, select either the CompuStar Model 20, 30 or 40. Each can be used as either a stand-alone workstation or tied into a multi-user network. The Model 20 incorporates all of the features of the Model 10 with the addition of two, double-density mini-floppies built right in. And it boasts over 350,000 bytes of local, off-line user storage. The Model 30 also features a dual drive system but offers over 700,000 bytes of disk storage. And, the Model 40 boasts nearly 1½ million bytes of dual disk storage. But no matter which model you select, you'll enjoy unparalleled versatility in configuring your multi-user network.

Add as many terminals as you like - at prices starting at less than $2500. Now that's truly incredible!

No matter what your application, the CompuStar can handle it! Three disk storage options are available. A tabletop 10 megabyte 8" winchester-type drive complete with power supply and our special controller and multiplexor costs just $3995. Or, if your disk storage needs are more demanding, select either a 32 or 96 megabyte Control Data CMD drive with a 16 megabyte removable, top loading cartridge. Plus, there's no fuss in getting a CompuStar system up and running. Just plug in a Video Processing Unit and you're ready to go . . . with up to 254 more terminals in the network by simply connecting them together in a "daisy-chain" fashion. CompuStar's special parallel interface allows for system cable lengths of up to one mile . . . with data transfer rates of 1.6 million BPS!

Software costs are low, too. CompuStar's disk operating system is the industry standard CP/M*. With an impressive array of application software already available and several communication packages offered, the CompuStar can tackle even your most difficult programming tasks.

Compare for yourself. Of all the microcomputer-based multi-user systems available today, we know of only one which offers exactly what you need and should expect. Exceptional value and upward growth capability. The CompuStar™. A true price and performance leader!



2300 Broad River Rd. Columbia, SC 29210
(803) 798-9100 TWX: 810-666-2115

*Registered trademark of Digital Research, Inc.

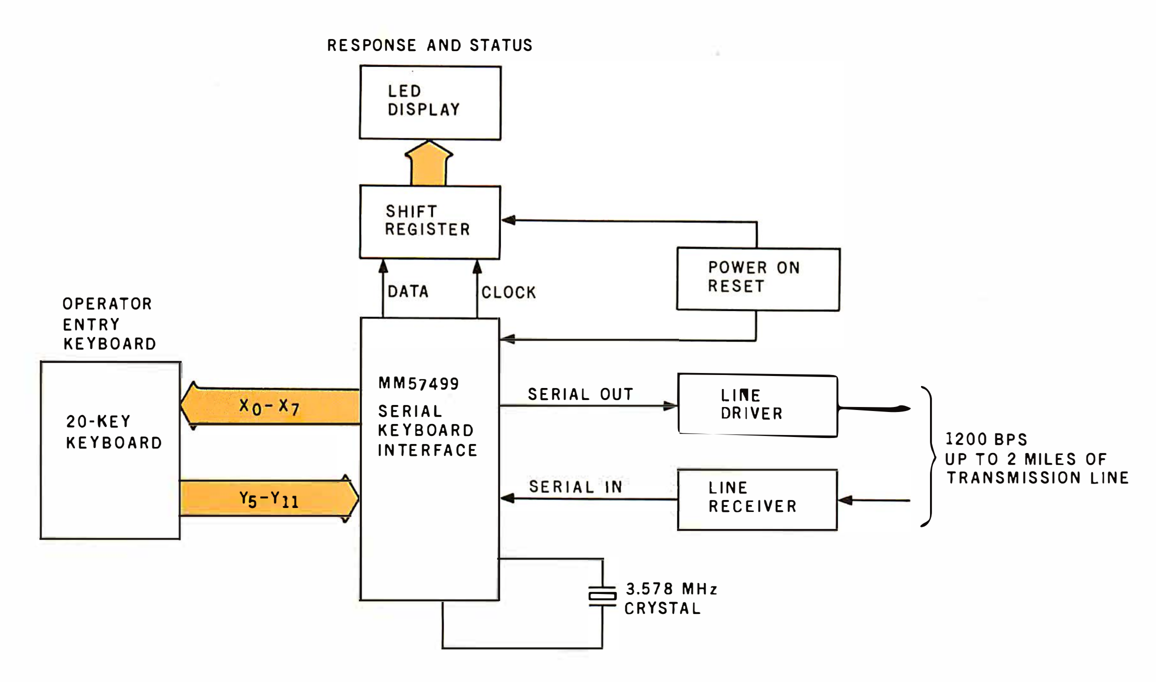


Figure 1: *Block diagram of a minimal-component remote-entry panel, capable of serial communication with most host computers.*

to the computer. The first time it is transmitted, a hexadecimal F9 is affixed to the beginning of the message to tell the computer that the terminal is no longer in the programming mode. At any time after this point, whenever a Control-semicolon is pressed, the stored password will be transmitted. Reprogramming this phrase is accomplished by simply pressing Control-Escape again and repeating the sequence.

Receiving data from the control computer in response to an operator input is where the real power of this interface becomes apparent. The computer can signify the acceptance or rejection of a command input, or the completion of a task by turning on one of the LEDs connected to IC2.

Text continued on page 42

Circle 19 on inquiry card.

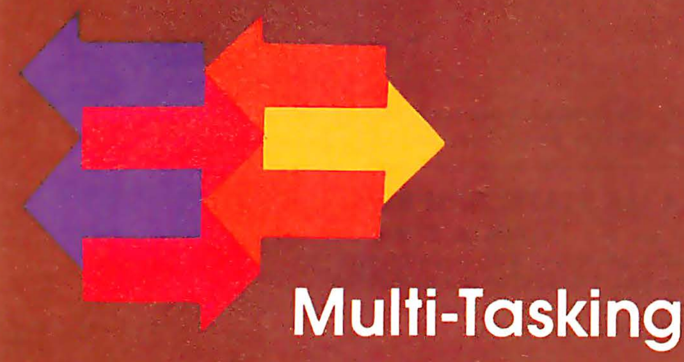
Circle 20 on inquiry card. →





Multi-User

UniFLEX is the first full capability multi-user operating system available for microprocessors. Designed for the 6809 and 68000, it offers its users a very friendly computing environment. After a user 'logs-in' with his user name and password, any of the system programs may be run at will. One user may run the text editor while another runs BASIC and still another runs the C compiler. Each user operates in his own system environment, unaware of other user activity. The total number of users is only restricted by the resources and efficiency of the hardware in use.



Multi-Tasking

UniFLEX is a true multi-tasking operating system. Not only may several users run different programs, but one user may run several programs at a time. For example, a compilation of one file could be initiated while simultaneously making changes to another file using the text editor. New tasks are generated in the system by the 'fork' operation. Tasks may be run in the background or 'locked' in main memory to assist critical response times. Inter-task communication is also supported through the 'pipe' mechanism.



Support

The design of UniFLEX, with its hierarchical file system and device independent I/O, allows the creation of a variety of complex support programs. There is currently a wide variety of software available and under development. Included in this list is a Text Processing System for word processing functions, BASIC interpreter and precompiler for general programming and educational use, native C and Pascal compilers for more advanced programming, sort/merge for business applications, and a variety of debug packages. The standard system includes a text editor, assembler, and about forty utility programs. UniFLEX for 6809 is sold with a single CPU license and one years maintenance for $450.00. Additional yearly maintenance is available for $100.00. OEM licenses are also available.

FLEX™

UniFLEX is offered for the advanced microprocessor systems. FLEX, the industry standard for 6800 and 6809 systems, is offered for smaller, single user systems. A full line of FLEX support software and OEM licenses are also available.



Box 2570, West Lafayette, IN 47906
(317) 463-2502 Telex 276143

™UniFLEX and FLEX are trademarks of Technical Systems Consultants, Inc.

Matrix Connections X	Y	Standard Code	With Control Key Pressed	With Shift and Control Pressed	With Shift Key Pressed	Key
0	0	80	80	80	80	FN1
1	0	81	81	81	81	FN2
2	0	82	82	82	82	FN3
3	0	83	83	83	83	FN4
4	0	84	84	84	84	FN5
5	0	85	85	85	85	FN6
6	0	86	86	86	86	FN7
7	0	87	87	87	87	LS
0	1	88	88	88	88	IC
1	1	89	89	89	89	ADM
2	1	8A	8A	8A	8A	DE
3	1	8B	8B	8B	8B	BTAB
4	1	8C	8C	8C	8C	SC
5	1	8D	8D	8D	8D	CLEAR
6	1	8E	8E	8E	8E	EOS
7	1	8F	8F	8F	8F	EOL
0	2	90	90	90	90	BS
1	2	91	91	91	91	DL
2	2	92	92	92	92	DC
3	2	93	93	93	93	IL
4	2	94	94	94	94	FMT
5	2	95	95	95	95	↑
6	2	96	96	96	96	↓
7	2	97	97	97	97	→
0	3	98	98	98	98	←
1	3	09	09	09	09	TAB
2	3	08	08	08	08	BS
3	3	7B	7B	7B	7B	{
4	3	7C	7C	7C	7C	¦
5	3	7D	7D	7D	7D	}
6	3	7E	7E	7E	7E	~
7	3	5F	1F	1F	1F	—
0	4	30	30	30	30	0
1	4	31	31	31	31	1
2	4	32	32	32	32	2
3	4	33	33	33	33	3
4	4	34	34	34	34	4
5	4	35	35	35	35	5
6	4	36	36	36	36	6
7	4	37	37	37	37	7
0	5	38	38	38	38	8
1	5	39	39	39	39	9
2	5	0A	0A	0A	0A	LF
3	5	1B	1B	1B	1B	ESC
4	5	20	20	20	20	SP
5	5	0D	0D	0D	0D	RTN
6	6	2E	2E	2E	2E	.
7	5	FF	FF	FF	FF	BREAK

Matrix Connections X	Y	Standard Code	With Control Key Pressed	With Shift and Control Pressed	With Shift Key Pressed	Key
0	6	30	30	30	30	0
1	6	31	31	21	21	1
2	6	32	32	22	22	2
3	6	33	33	23	23	3
4	6	34	34	24	24	4
5	6	35	35	25	25	5
6	6	36	36	26	26	6
7	6	37	37	27	27	7
0	7	38	38	28	28	8
1	7	39	39	29	29	9
2	7	3A	3A	2A	2A	:
3	7	3B	3B	2B	2B	;
4	7	2C	2C	3C	3C	,
5	7	2D	2D	3D	3D	-
6	7	2E	2E	3E	3E	.
7	7	2F	2F	3F	3F	/
0	8	40	00	00	60	@
1	8	61	01	01	41	A
2	8	62	02	02	42	B
3	8	63	03	03	43	C
4	8	64	04	04	44	D
5	8	65	05	05	45	E
6	8	66	06	06	46	F
7	8	67	07	07	47	G
0	9	68	08	08	48	H
1	9	69	09	09	49	I
2	9	6A	0A	0A	4A	J
3	9	6B	0B	0B	4B	K
4	9	6C	0C	0C	4C	L
5	9	6D	0D	0D	4D	M
6	9	6E	0E	0E	4E	N
7	9	6F	0F	0F	4F	O
0	10	70	10	10	50	P
1	10	71	11	11	51	Q
2	10	72	12	12	52	R
3	10	73	13	13	53	S
4	10	74	14	14	54	T
5	10	75	15	15	55	U
6	10	76	16	16	56	V
7	10	77	17	17	57	W
0	11	78	18	18	58	X
1	11	79	19	19	59	Y
2	11	7A	1A	1A	5A	Z
3	11		ON→FC			Cap Loc
4	11		ON→FE			Shift Loc
5	11					RPT
6	11		No Code			CNTR
7	11					SHIFT

Table 1: *Hexadecimal key-code assignments. Using this set of assignments, the computer can reply to data entered at the terminal. The data received at the remote terminal is displayed on eight LED indicators or an optional two-digit hexadecimal readout.*

ALTOS COMPUTER SYSTEMS PROUDLY ANNOUNCES



ACS8000-6



THE VERY FIRST

Double Density Z80 Micro-Computer
plus Twin 8" Floppies
plus 14.5Mb Winchester Disk
for under $9,500!
And more! 4 user CP/M® for under $12,000!

®CP/M is a registered trademark of Digital Research, Inc.

ALTOS COMPUTER SYSTEMS, LEADER IN SINGLEBOARD TECHNOLOGY DOES IT AGAIN WITH ITS SINGLEBOARD ACS8000-6. TOTAL BUSINESS COMPUTER

HIGH TECHNOLOGY AGAIN

The new ACS8000-6 single board computer is packed with ultra-high technology: Z80 double-density computer, up to 208Kb of high speed RAM, Floppy-disk and Winchester Hard Disk controllers, DMA, up to 6 serial/2 Parallel I/O, optional 32 bit floating point processor . . . All on One Board, fully socketed, fully documented reliable and maintainable.

ADVANCED MULTI-USER SOFTWARE

Our new ALTOS Multi-User Executive (AMEX) supports four independent CP/M compatible programs in any of six languages: Basic, Fortran, Cobol, Pascal, APL, C, and a wealth of complete business application packages.

WINCHESTER MASS STORAGE

We're staying with Shugart for both floppies and Winchester hard disk. Why? Simple, low price, solid reliability and they're our next door neighbor. Our single board computer supports up to 4 Mbytes of floppies and 58 Mbytes of Winchester running under AMEX.

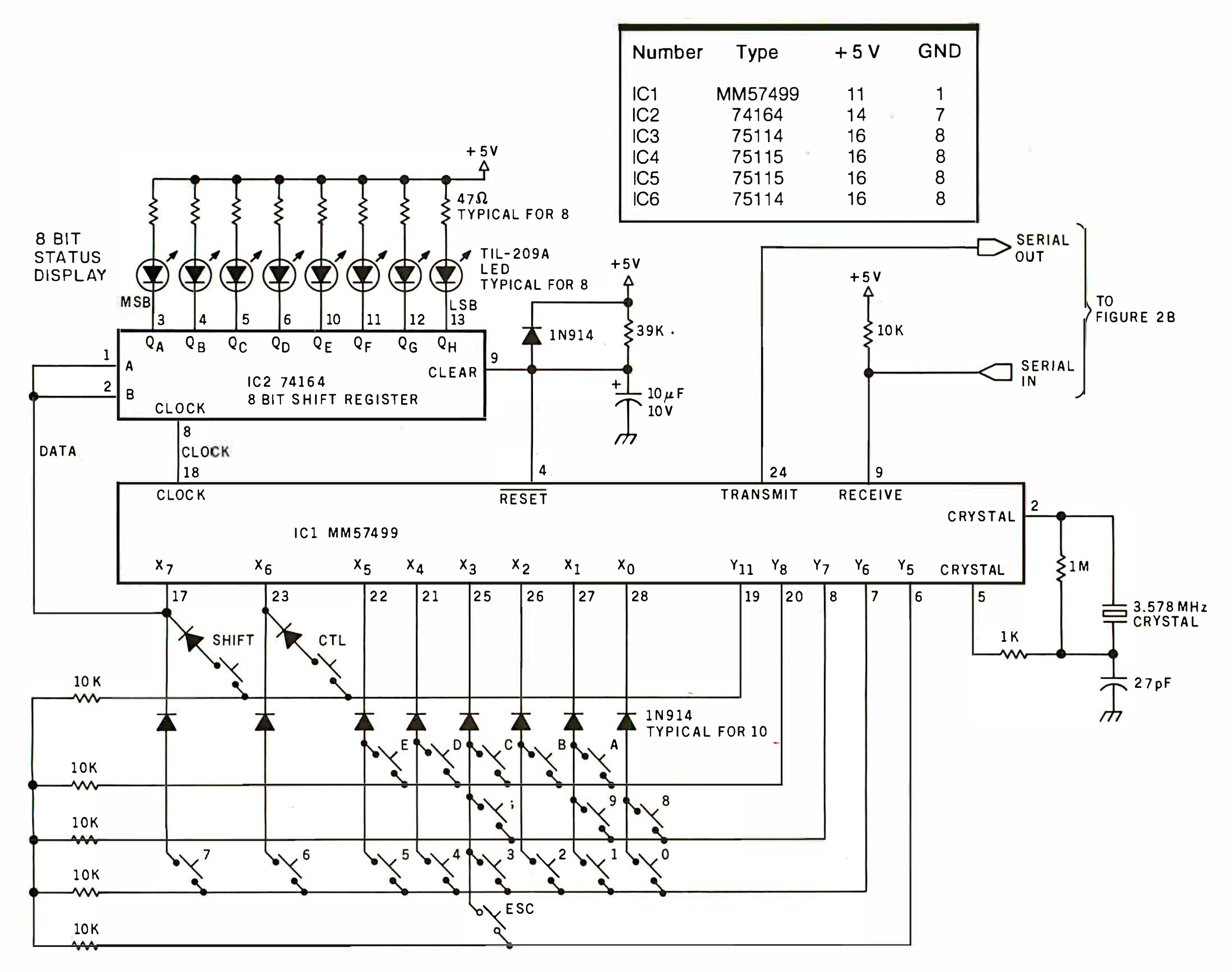
MINI PERFORMANCE FOR 1/2 COST

Prices you will love. Entry level ACS8000-6 Hard Disk System $9,450 2 users $10,670, 4 users $11,960, AMEX separate at $250.

AVAILABLE NOW!

Call for your nearest Altos dealer. (408) 946-6700. Telex 171562 ALTOS SNTA.

ALTOS
COMPUTER SYSTEMS
2360 Bering Drive
San Jose, CA 95131



Number	Type	+5 V	GND
IC1	MM57499	11	1
IC2	74164	14	7
IC3	75114	16	8
IC4	75115	16	8
IC5	75115	16	8
IC6	75114	16	8

Figure 2a: *Schematic of the remote data-entry terminal. Use of the MM57499 serial keyboard-interface circuit allows for simple construction. Data is entered via a standard keypad, and encoded by the interface circuit. Data may then be sent serially at 1200 bps to the computer over any of a number of types of transmission line.*

In this circuit, all diodes are 1N914s, and not all Yn lines are used since a hexadecimal keypad does not require them. Holding any key down causes a 15-cps automatic repeat.

Atari & Commodore Dealers:
VisiCalc available for PET/CBM
and Atari 800! Call 800-538-8583

Solve your personal energy crisis. Let VisiCalc™ Software do the work.

With a calculator, pencil and paper you can spend hours planning, projecting, writing, estimating, calculating, revising, erasing and recalculating as you work toward a decision.

Or with the Personal Software™ VisiCalc program and your Apple* II you can explore many more options with a fraction of the time and effort you've spent before.

VisiCalc is a new breed of problem-solving software. Unlike prepackaged software that forces you into a computerized straight jacket, VisiCalc adapts itself to any numerical problem you have. You enter numbers, alphabetic titles and formulas on your keyboard. VisiCalc organizes and displays this information on the screen. You don't have to spend your time programming.

Your energy is better spent using the results than getting them.

Say you're a business manager and want to project your annual sales. Using the calculator, pencil and paper method, you'd lay out 12 months across a sheet and fill in lines and columns of figures on products, outlets, salespeople, etc. You'd calculate by hand the subtotals and summary figures. Then you'd start revising, erasing and recalculating. With VisiCalc, you simply fill in the same figures on an electronic "sheet of paper" and let the computer do the work.

Once your first projection is complete, you're ready to use VisiCalc's unique, powerful recalculation feature. It lets you ask "What if?," examining new options and planning for contingencies. "What if" sales drop 20 percent in March? Just type in the sales figure. VisiCalc instantly updates all other figures affected by March sales.

Or say you're an engineer working on a design problem and are wondering "What if that oscillation were damped by another 10 percent?" Or you're working on your family's expenses and wonder "What will happen to our entertainment budget if the heating bill goes up 15 percent this winter?" VisiCalc responds instantly to show you all the consequences of any change.

Once you see VisiCalc in action, you'll think of many more uses for its power. Ask your dealer for a demonstration and discover how VisiCalc can help you in your professional work and personal life.

You might find that VisiCalc alone is reason enough to own a personal computer.

VisiCalc is available now for Apple II computers with versions for other personal computers coming soon. The Apple II version requires a 32k disk system.

For the name and address of your nearest VisiCalc dealer, call (408) 745-7841 or write to Personal Software, Inc., 592 Weddell Dr., Sunnyvale, CA 94086. If your favorite dealer doesn't already carry Personal Software products, ask him to give us a call.



PERSONAL SOFTWARE

VisiCalc was developed exclusively for Personal Software by Software Arts, Inc., Cambridge, Mass.

Circle 24 on inquiry card.

TM—VisiCalc is a trademark of Personal Software, Inc.

*Apple is a registered trademark of Apple Computer, Inc.

REMOTE ENTRY PANEL

COMPUTER

+5V
1K
IC4
SN75115
50Ω
50Ω
0.1μF *
IC1 PIN 9
SERIAL DATA
INPUT
TO FIGURE 2A

IC6
SN75114
+5V
1K
TTL
SERIAL IN
1200 BPS

100Ω
TRANSMISSION
LINE

+5V
1K
IC3
SN75114
IC1 PIN 24
SERIAL DATA
OUTPUT
FROM FIGURE 2A

+5V
1K
IC5
SN75115
50Ω
50Ω
0.1μF *
TTL
SERIAL
OUT
1200 BPS

Figure 2b: *Transmission-line drivers for the terminal are capable of transmitting over 10,000 feet of 100-ohm line. The capacitors at pin 4 of IC4 and IC5 help to reduce noise pick-up by decreasing the frequency response of the receiver.*

Pin	Left side	Right side	Pin
1	GND	X_0	28
2	CRYSTAL	X_1	27
3	CRYSTAL	X_2	26
4	$\overline{RESET}$	X_3	25
5	Y_4	TRANSMIT OUT	24
6	Y_5	X_6	23
7	Y_6	X_5	22
8	Y_7	X_4	21
9	RECEIVE INPUT	Y_8	20
10	Y_9	Y_{11}	19
11	V_{CC}	CLOCK OUT	18
12	Y_0	DATA OUT (X_7)	17
13	Y_1	Y_{10}	16
14	Y_2	Y_3	15

MM57499

Figure 2c: *The MM57499 serial keyboard-encoder integrated circuit, which scans a 12 by 8 matrix and produces the appropriate ASCII code for each key.*

SCAN LINES	X_7	X_6	X_5	X_4	X_3	X_2	X_1	X_0
Y_{11}	SHIFT KEY	CONTROL	REPEAT	CAP LOCK	SHIFT LOCK	Z z	Y y	X x
Y_{10}	W w	V v	U u	T t	S s	R r	Q q	P p
Y_9	O o	N n	M m	L l	K k	J j	I i	H h
Y_8	G g	F f	E e	D d	C c	B b	A a	□ @
Y_7	? /	> .	= -	< ,	+ ;	* :	) 9	(8
Y_6	' 7	& 6	% 5	$ 4	# 3	" 2	! 1	o 0
Y_5	BREAK	·	RTN	SP	ESC	LF	9	8
Y_4	7	6	5	4	3	2	1	0
Y_3	DEL —	^ ~	] }	\ ¦	[{	BS	TAB	←
Y_2	→	↓	↑	FMT	IL	DC	DL	FS
Y_1	EOL	EOS	CLEAR	SC	B TAB	DE	ADM	IC
Y_0	LS	FN7	FN6	FN5	FN4	FN3	FN2	FN1

STROBE LINES

Figure 3: *Key function chart. Although not all scan lines are used for the hexadecimal keypad, the MM57499 circuit is capable of encoding the full ASCII character set. In the unit described, shorting X_3 and Y_5 produces an ESC (Escape) code, while shorting X_5 and Y_5 gives the code for 5.*

Text continued from page 34:

This is accomplished by sending an ASCII character to the entry receiver that has a key code corresponding to the bits we wish to light. These codes are listed in table 1.

For example, to light the LSB (least-significant bit) of the display, a hexadecimal 01 is sent. This corresponds to a "Control-shift-A". The Break key code FF would turn on all the indicators. To successfully use these LEDs, a lookup table and bit map should be included in any software driver for the terminal. My prototype included both an 8-bit LED display and a two-digit hexadecimal display. They are wired in parallel and display the same information.

Long Distance Transmission

No one bothers to construct a remote-entry terminal for placement next to the control computer. In most cases you will not have to resort to extraordinary means to communicate a couple hundred feet. Should you need to communicate long distances, such as 3000 feet to the barn, the line-driver circuitry of figure 2 should be used. It is capable of driving 10,000 feet of 100-ohm transmission line. For short distances it isn't absolutely necessary to use this wire or circuit. A pair of MC1488 and MC1489 RS-232C drivers can be substituted for short runs and twisted-pair wiring used instead of 100-ohm cable. The degree of leeway allowed depends upon the electrical noise between the terminal and the computer. If in doubt, use the heavy-duty driver I've outlined.

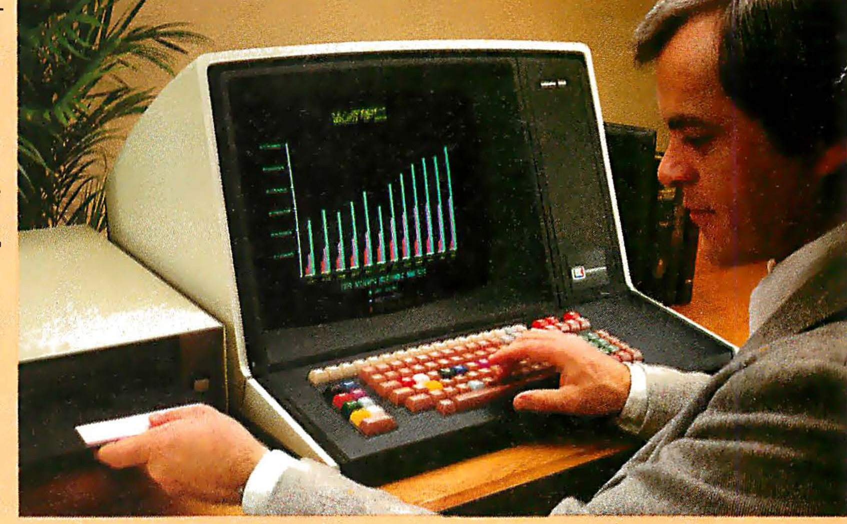
Whether you build this interface or not is immaterial so long as you recognize the advantages it presents for those readers interested in control applications. I've only scratched the surface concerning the capabilities of the MM57499. We could also have used it as a single-chip remote-status transmitter, or we could have expanded the receiver section for full message displays. Trying to cover all potential applications is impossible in a single article. I assure you that I am not through with this device, and I'll think up a few more gadgets that use it. If in the meantime you have any brainstorms concerning home control, I'd appreciate hearing about them.

For information on the MM57499 write to:

Mike Van Slack
Product Marketing Engineer
National Semiconductor
2900 Semiconductor Dr
Santa Clara CA 95051

Next Month: *We will explore some ways to use LCDs (liquid-crystal displays).* ■

If you can type, you can handle your accounting, word processing and much more on ISC's Small Business Computer!



The Intecolor® 8963 is just one of a complete line of ISC desktop computers designed for businessmen who don't know how— or don't have time— to write programs. It's CP/M® compatible, so you can choose *from* hundreds of CP/M business programs— programs that have been proven in hundreds of actual applications.

Programs like General Ledger, Accounts Receivable and Payable, Payroll, Mailing List and Inventory Control are now available *in color*. You'll comprehend data faster, thanks to the proven readability of ISC's eight-color display.

To compose letters and other documents quickly and easily, you'll want ISC's unique *color-coded* Word Processing program. With an optional printer, you can print out as many mistake-free originals as you want!

The Intecolor 8963 gives you all the benefits of color graphics computing at a price that's competitive with black-and-white. It's complete with 19" color graphics display, typewriter-like keyboard, dual disk drive for data storage — even a color version of Microsoft® Business BASIC for those of you who *do* want to program.

Don't let your business get behind the times. Call your ISC sales representative or visit your nearest Factory Authorized ISC dealer and get a "hands on" demonstration *today*.

Color Communicates BetterSM

* U.S. domestic price. Unretouched photo of screen. CP/M is a registered trademark of Digital Research Corp.

OEM Quantity Discounts are available to Qualified Dealers and Volume Users of 25 Systems (or greater) per year. Call your nearest ISC Representative listed below.

ISC SALES REPRESENTATIVES: AL: 205/883-8660, **AZ:** 602/994-5400, **AR:** (TX) 214/661-9633, **CA:** Alhambra 213/281-2280, Goleta 805/964-8751, Irvine 714/557-4460, Los Angeles 213/476-1241, Los Altos 415/948-4563, San Diego 714/292-8525, **CO:** 303/355-2363, **CT:** 203/624-7800, **DE:** (PA) 215/542-9876, **DC:** (VA) 703/569-1502, **FL:** Ft. Lauderdale 305/776-4800, Melbourne 305/723-0766, Orlando 305/425-5505, Tallahassee 904/878-6642, **GA:** Atlanta 404/455-1035, **HI:** 808/524-8633, **ID:** (UT) 801/292-8145, **IL:** (No.) 312/564-5440, (So. MO) 816/765-3337, **IN:** (IL) 312/564-5440, **IA:** (Scott County Only) 312/564-5440, (MO) 816/765-3337, **KS:** (MO) 816/765-3337, **KY:** 606/273-3771, **LA:** 504/626-9701, **ME:** (MA) 617/729-5770, **MD:** (VA) 703/569-1502, **MA:** 617/729-5770, **MI:** Brighton 313/227-7067, Grand Rapids 616/393-9839, **MN:** 612/645-5816, **MS:** (AL) 205/883-8660, **MO:** 816/765-3337, **MT:** (CO) 303/355-2363, **NB:** (MO) 816/765-3337, **NH:** (MA) 617/729-5770, **NJ:** (No.) 201/224-6911, (So.) 215/542-9876, **NV:** (AZ) 602/994-5400, **NM:** 505/292-1212, **NY:** Metro/LI(NJ) 201/224-6911, N. Syracuse 315/699-2651, Fairport 716/223-4490, Utica 315/732-1801, **NC:** 919/682-2383, **ND:** (MN) 612/645-5816, **OH:** Cleveland 216/398-0506, Dayton 513/435-7684, **OK:** (TX) 214/661-9633, **OR:** 503/644-5900, **PA:** (E) 215/542-9876, (W) 412/922-5110, **RI:** (MA) 617/729-5770, **SC:** 803/798-8070, **SD:** (MN) 612/645-5816, **TN:** 615/482-5761, **TX:** Austin 512/454-3579, Dallas 214/661-9633, El Paso Area (Las Cruces, NM) 505/524-9693, Houston Only 713/681-0200, **UT:** 801/292-8145, **VT:** (MA) 617/729-5770, **VA:** 703/569-1502, **WA:** 206/455-9180, **WV:** (PA) 412/922-5110, **WI:** (IL) 312/564-5440, **WY:** (CO) 303/355-2363,

EUROPEAN EXPORT SALES: EUROPE: (MA) 617/661-9424, **BELGIUM:** Brussels 02-242-36-04, **DENMARK:** 02-913255, **FRANCE:** Rueil Malmaison 749-47-65, Paris 33-1-306-4606, **GREECE:** Athens 642-1368, **ITALY:** Milano 02600733, **THE NETHERLANDS:** Poeldijk 01749-47640, Amsterdam 020-360904, **SPAIN:** Barcelona 204-17-43, **SWEDEN:** Vallingby 08-380-370, **SWITZERLAND:** Mutschellen 057-546-55, **UNITED KINGDOM:** Bournemouth 0201671181, **WEST GERMANY:** Koblenz 01149-31025/6, **AUSTRALIA & NEW ZEALAND:** Auckland 876-570, Canberra 58-1811, Chermside 59-6436, Christchurch 796-210, Melbourne 03-543-2077, Sydney 02-808-1444, Wellington 644-585, **CANADA:** Dorval 514/636-9774, Ottawa 613/224-1391, Toronto 416/787-1208, Vancouver 604/684-8625, **CENTRAL AND SOUTH AMERICA & CARIBBEAN:** (GA) 404/394-9603, **MEXICO:** Monterrey 564-876, **FAR EAST:** (CA) 213/382-1107, **HONG KONG:** 5-742211, **JAPAN:** (Tokyo) (03) 463-9921, **TAIWAN:** (Taipei) 02-7026284, **MIDDLE EAST:** (GA) 404/581-0243, **EGYPT:** 809933, **ISRAEL:** Ramat Gan 03725749, **KUWAIT:** Kuwait 438-180/1/2, **LEBANON:** Beirut 221731/260110, **SAUDI ARABIA:** Jeddah 27790, Riyadh 25083-39732.

For sales and service in other countries contact ISC headquarters in Norcross, GA., U.S.A.



Intecolor Drive □ 225 Technology Park/Atlanta □ Norcross, GA 30092 □ Telephone 404/449-5961 □ TWX 810-766-1581

Your vehicle for com
The Challenger 8P DF.

The general purpose microcomputer was first introduced as a computer for hobbyists and experimenters. However, as the industry has grown, microcomputers have become specialized for personal use or for small business use. There is virtually no computer for the serious experimenter with one important exception, the Ohio Scientific Challenger 8P.

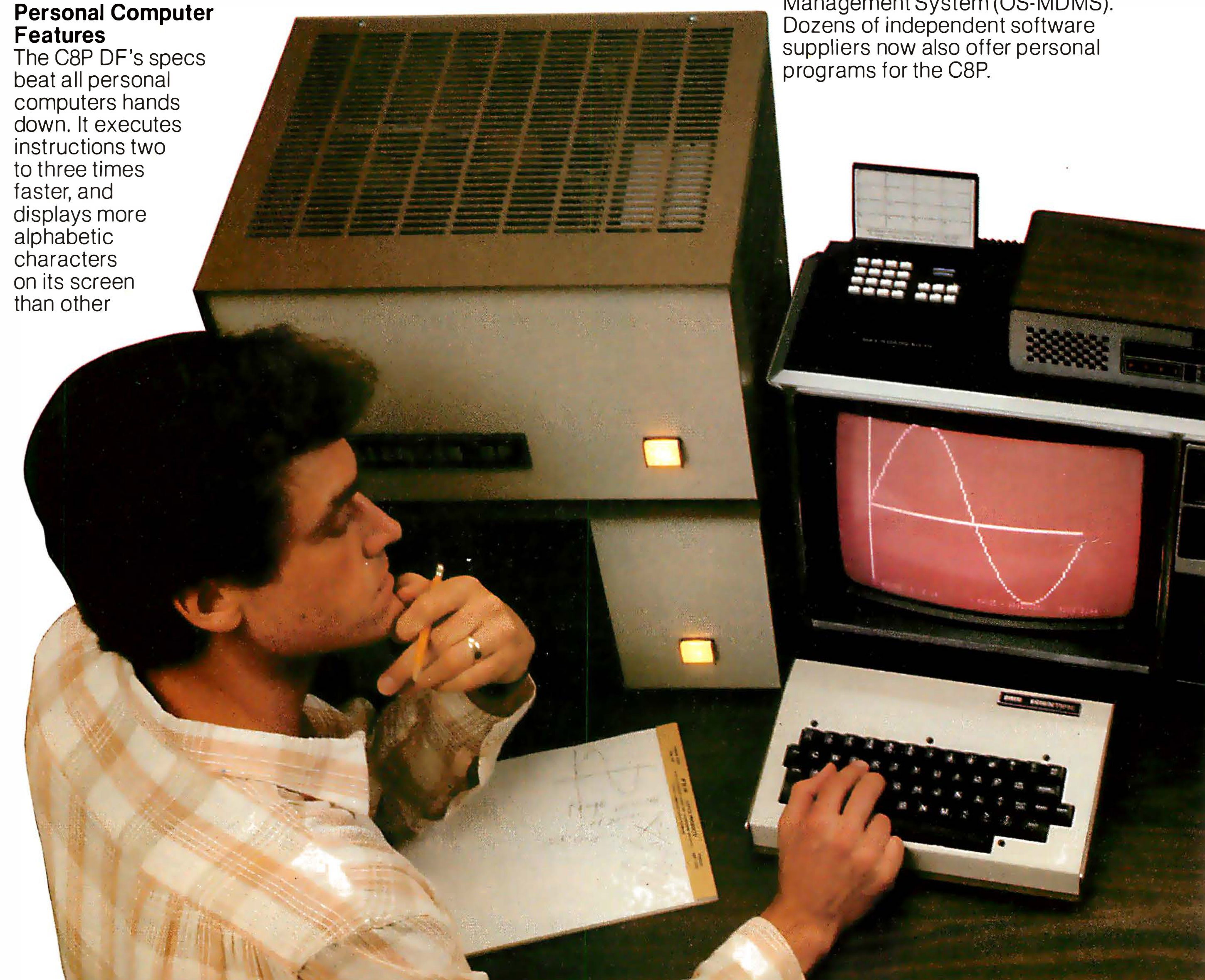
The C8P is unique in that it incorporates the features of state-of-the-art personal computers, with the memory and disk storage capacity of business computers, along with the "mainframe" bus architecture and open ended expansion capability of industrial control computers.

Personal Computer Features

The C8P DF's specs beat all personal computers hands down. It executes instructions two to three times faster, and displays more alphabetic characters on its screen than other models. It has upper and lower case and graphics in 16 colors. The C8P's *standard* I/O capabilities are far more extensive than any other computer, with joystick and keypad interfaces, sound output, an 8-bit D/A converter, 16 parallel I/O lines, modem and printer interfaces, AC remote control and security monitor interfaces and a universal accessory port that accepts a prom blaster, 12-bit analog I/O module, solderless prototyping board and more.

Ohio Scientific offers a large library of personal applications programs, including exciting action games such as Invaders and Star Trek, sports simulations, games of logic and educational games, personal applications such as biorhythms, calorie counter, home programs such as checking and savings account balancers and a home budgeter just to name a few. A new Plot BASIC makes elaborate animations easy, and music composition program allows you to play complex multi-part music through the computers DAC.

At the systems level the machine comes standard with OS-65D, an advanced disk operating system with Microsoft BASIC and an interactive Assembler Editor. Optional software includes UCSD PASCAL and FORTRAN and an Information Management System (OS-MDMS). Dozens of independent software suppliers now also offer personal programs for the C8P.



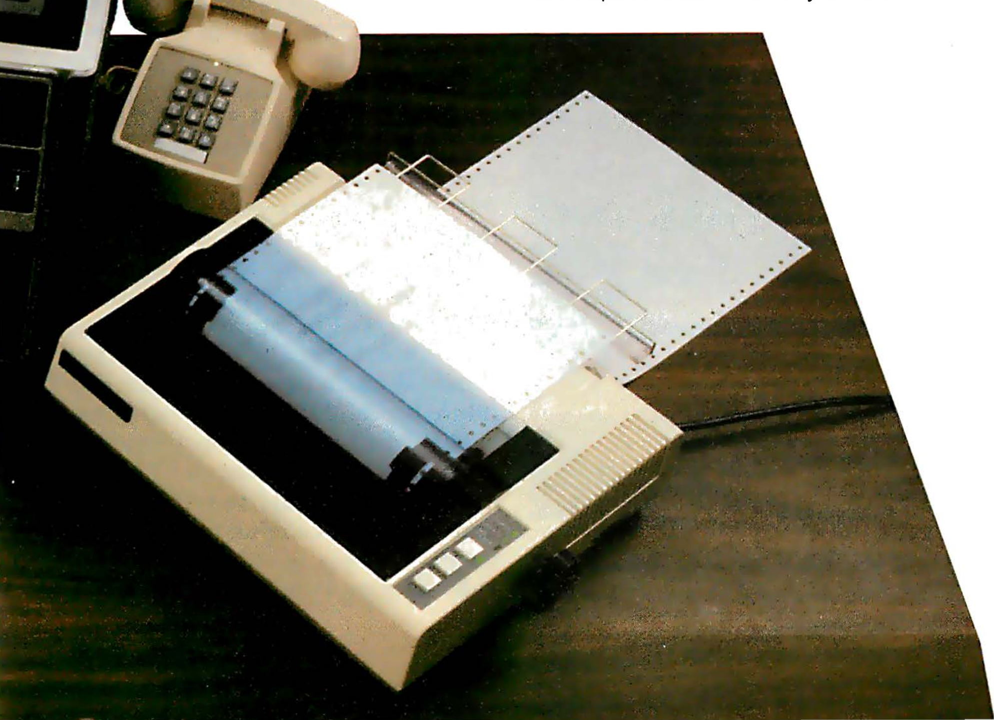
puter explorations.

Business Computer Features
The C8P DF utilizes dual 8″ floppy disk drives which store up to eight times as much information as personal computer mini-floppies, and an available double-sided option expands capacity to 1.2 megabytes of on-line storage. The C8P DF is compatible with Ohio Scientific's business computer software, including OS-65U an advanced operating system, and an Information Management System (OS-DMS) with supplementary inventory, accounting, A/R-A/P, payroll, purchasing, estimation, educational grading and financial modeling packages. The system also supports word processing (WP-3) and a fully integrated small business accounting system (OS-AMCAP V1.6). The C8P DF's standard modem and printer ports accept high-speed matrix printers and word-processing printers directly.

Home Control and Industrial Control
The C8P DF has the most advanced home monitoring and control capabilities ever offered in a computer system. It incorporates a real time clock and a unique FOREGROUND/BACKGROUND operating system which allows the computer to function with normal BASIC programs, at the same time it is monitoring external devices. The C8P DF comes standard with an AC remote control interface, which allows it to control a wide range of AC appliances and lights remotely, without wiring, and an interface for home security systems which monitors fire, intrusion, car theft, water levels and freezer temperature, all without messy wiring. In addition, the C8P DF can accept Ohio Scientific's Votrax voice I/O board and/or Ohio Scientific's new universal telephone interface (UTI). The telephone interface connects the computer to any telephone line. The computer system is able to answer calls, initiate calls and communicate via touch-tone signals, voice output or 300 baud modem signals. It can accept and decode touch-tone signals, 300 baud modem signals and record incoming voice messages. These features collectively give the C8P DF capabilities to monitor and control home functions with almost human-like capabilities.

For process control applications, a battery back up calendar clock with automatic computer restart capabilities is available. Ohio Scientific's unique accessory ports allow the connection of a nearly unlimited number of 48 line parallel I/O cards and 12-bit high speed instrumentation quality analog I/O modules to the computer by inexpensive 16-pin ribbon cables.

Exploring New Frontiers
Ohio Scientific's vocalizer software processes normal BASIC print statements with conventional spellings and speaks them clearly in real-time on computers equipped with the UTI (CA-15B or CA-14A). This voice output capability, combined with the C8P's remote control, remote sensing, telephone interface capabilities and reasonable cost open up new frontiers for computer applications.



Documentation
The C8P DF is not a beginner's computer and doesn't come with beginner's documentation. However, Ohio Scientific does offer detailed documentation on the computer which is meaningful for experts, including a Howard Sams produced hardware service manual that includes detailed block diagrams, schematics, parts placement diagrams and parts lists. Ohio Scientific is now also offering fully documented Source Code in machine readable form for OS-65D, the Challenger 8P's operating system allowing experimenters and industrial users to customize the system to their specific applications.

What's Next?
Ohio Scientific is working on a speech recognizer to complement the UTI system, with a several hundred word vocabulary. The company is also developing an 8 megabyte low-cost, add-on hard disk for use in conjunction with natural language parsing to further advance the state-of-the-art in small computers. The modular bus architecture of the C8P assures system owners of being able to make use of these new developments as they become available just as the owner of a 1976 vintage Challenger can directly plug in voice output, the UTI and other current state-of-the-art OSI products.

The C8P DF with dual 8″ floppies, BASIC and two operating systems costs about $3000, only slightly more than you would pay for a dual mini-floppy equipped personal computer with only a fraction of the capabilities of the C8P.

For more information and the name of the dealer nearest you, call 1-800-321-6850 toll free.

OHIO SCIENTIFIC
1333 SOUTH CHILLICOTHE ROAD
AURORA, OH 44202 • [216] 831-5600

An 8088 Processor for the S-100 Bus

Part 1

Thomas Woodward Cantrell
2475 Borax Dr
Santa Clara CA 95051

The 16-bit microprocessor has definitely arrived. No one doubts that this new wave of high-performance processors will soon be operating on the familiar S-100 bus. In fact, Seattle Computer Products is already shipping its Intel 8086-based processor card, along with a support card that includes vectored-interrupt control, hardware mathematical operations, and miscellaneous timer/counters.

Godbout Electronics has designed a card containing two microprocessors and the logic allowing transfer of control between them by software. One of the processors on this board is an Intel 8085A-2, which allows the board to be placed in 8080A/8085A/Z80A-based S-100 systems with a minimum amount of hassles.

Using various existing or soon-to-be-developed cross-software products, programs can be developed for the other processor on the board, the Intel 8088. When the new software is developed and loaded, control can be transferred from one microprocessor circuit to the other for checkout and debugging. This is a novel solution to the problem of bootstrapping a system consisting of both new hardware and new software.

Microsoft and Digital Research, both highly renowned producers of quality software, are making their contributions to the processor revolution. Microsoft is already shipping an 8086/8088 version of its popular BASIC interpreter as well as an 8086/8088 cross-macroassembler which runs under Digital Research's CP/M. A disk operating system and other system software are to follow.

Digital Research has an 8086/8088 based version of CP/M in the works. Expect this to be followed with new versions of MP/M and PL/I. The multitude of vendors who supply software to run under CP/M should already be converting their software for use with the new CP/M.

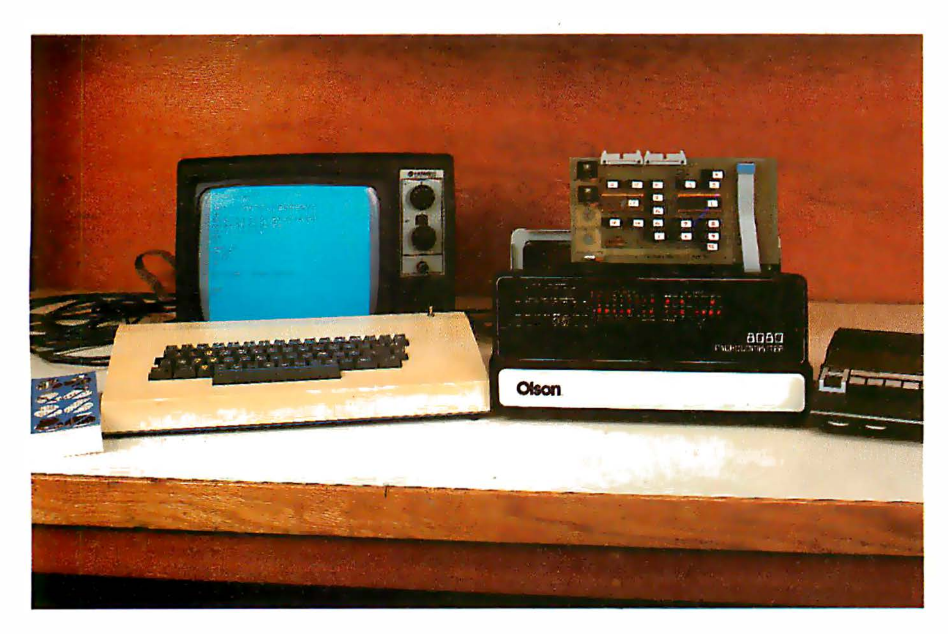


Photo 1: *A wolf in sheep's clothing. The panel may say "8080," but the processor card in this system is based on Intel's high-performance 8088.*

Problems Remain

Be that as it may, the S-100/16-bit processor picture is not as bright as it may seem. The fundamental problem is that the S-100 bus was originally designed by MITS (of Altair fame) for the Intel 8080, an 8-bit microprocessor. To "upgrade" the S-100 bus to the higher levels of performance offered by the new machines, certain problems must be addressed. The IEEE (Institute of Electrical and Electronics Engineers) Standards Committee, through its S-100 bus standard definition, has assured a future for the S-100 bus in two ways.

First, the problem of incompatibility between different "S-100" modules will be laid to rest. Woe be unto today's computerist who attempts to use a Brand X DMA color video-display board with a Brand Y

QUALITY

THAT'S WHAT SEPARATES THIS PRINTER FROM THE TOYS

MICROTEK
MT-80P

MICROTEK MT-80

SOLID VALUE FOR YOUR DOLLAR

The market is flooded with low-cost printers that look and last more like toys.

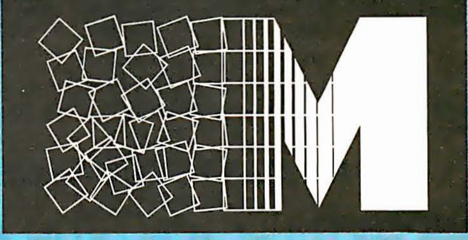
The Microtek MT-80, our versatile alphanumeric line printer, has a high quality print mechanism that gives you solid value for your dollar. It has been designed with a superior brain resulting in more advanced features and more dependable performance. Our printer is so reliable that we offer you an incredible 365 days warranty.

We stand behind every printer we make because we build quality into each one. So stop tinkering with toys and get serious. Demand 100% value by specifying the MT-80.

OUR UNIT PRICE
$795 Parallel
$895 Serial (RS-232C)

LOADED WITH INNOVATIONS

- 40, 80 or 120 columns (software selectable)
- Non-thermal paper, pin feed
- 125 CPS, 70 lines per minute
- 9 × 7 dot matrix
- Vertical format unit
- 96-character ASCII (upper and lower case)
- Adjustable forms width to 9½″
- Parallel and serial (RS-232C) interfaces available



MICROTEK inc.

For more information contact:
MICROTEK, Inc.,
9514 Chesapeake Drive,
San Diego, CA 92123
Tel.(714)278-0633
TWX 910-335-1269

Z80 processor card and a Brand Z dynamic memory board. If they *all* work together it's a miracle! By more clearly defining things like DMA (direct-memory access) protocols and timing, as well as eliminating some of the archaic or abused S-100 signals, board compatibility can more likely be assured.

Second, provisions have been made to ease the adaptation of new, higher-performance processors to the bus. This expandability has been achieved in three distinct ways:

- 16-Bit Data Transfers — MITS chose to split the 8080's bidirectional 8-bit data bus into separate input and output data buses. While the wisdom of this was often questioned, it has proven to be a saving grace. The IEEE S-100 standard adds two signals (SXTRQ*, Sixteen Request, and SIXTN*, Sixteen Acknowledge) to allow 16-bit data transfers by ganging the input and output data bus. (Note that throughout this article I will use the "*" notation to designate active low signals; this is the accepted usage in the IEEE standard.)
- Extended Memory Addressing — Eight of the unused S-100 bus lines have been designated as address lines A16 thru A23. With 24 address bits (A0 thru A23), 16 megabytes of memory can be addressed directly.
- Extended I/O (input/output) Addressing — The 8080 was capable of addressing 256 I/O ports. The 8-bit I/O port address was placed on both the low byte (A0 thru A7) and high byte (A8 thru A15) of the 16-bit address bus. The IEEE standard allows this echoing of the port address on both halves of the address bus, but recommends that A0 thru A15 be used for I/O addressing. The 16-bit I/O address gives S-100 systems the ability to directly utilize up to 64 K I/O ports.

These standardization efforts will allow a controlled evolution of the S-100 bus. However, I realize that of the dozens of S-100 boards I have (including some of very recent vintage), probably none meets the IEEE standard. I cannot afford to replace them

Buy now and get FREE Solid State Software™ Libraries.



TI Programmables lead the field in performance, quality and value. When you're choosing a programmable calculator consider: Power. Total software support. Flexibility. And price/performance. You'll discover a clear-cut answer. A TI Programmable 58C or 59.

The TI-59 has up to 960 program steps or up to 100 memories. Magnetic card read/write capability lets you record your own custom programs or those received from PPX (Professional Program Exchange).

The TI-58C features up to 480 program steps or 60 memories. And it has TI's Constant Memory™ feature that retains data and program information even when the calculator is turned off.

And now free modules give you that added productivity you need. From August 15 to October 31, 1980 is your special opportunity to purchase one of the world's most advanced programmable calculators. And get a minimum of $40 worth of free software modules with a TI-58C. Or, when you buy a TI-59, get a minimum of $80 worth of software modules and an $18 one-year membership in PPX. This will allow you to select up to 3 programs (from over 2,500) written by professionals in your field.

Visit your TI retailer for more information, and let him help you select the TI Programmable and free software that's right for you.

☐ I've bought a TI-58C, send me my free module. Here is my first choice and an alternate.
☐ I've bought a TI-59, send me my two free modules and my membership (which entitles me to select three programs from the source catalog at no charge). Here are my module choices and an alternate.

1. ______________ 2. ______________
3. ______________

Send to: TI Library Offer, P.O. Box 1984, Lubbock, TX 79408.
Return this coupon: (1) with customer information card (packed in box), (2) a dated copy of proof of purchase, between Aug 15 and Oct 31, 1980 — items must be postmarked by Nov 7, 1980.

Name ______________
Address ______________
City ______ State ______ Zip ______ BY
Calculator Serial Number (from back of unit) ______________

Please allow 30 days for delivery. Offer void where prohibited. Offer good in U.S. only.
TI reserves the right to substitute modules.

‡U.S. suggested retail for all Libraries is $40, except Farming, $55, and Pool Water Analysis, $45.
**For use with TI-59 only

Fifty Years of Innovation

Texas Instruments technology — bringing affordable electronics to your fingertips.

TEXAS INSTRUMENTS
INCORPORATED

*US suggested retail price.

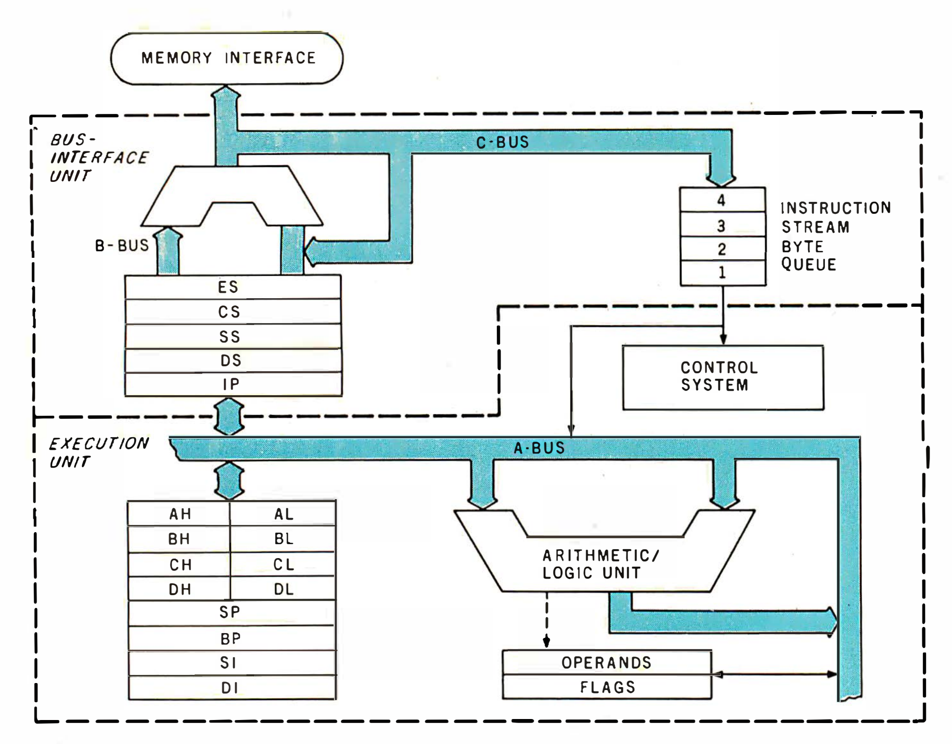


Figure 1: *The internal architecture of the 8088. By combining a 16-bit execution unit with an 8-bit bus-interface unit, the 8088 can use a powerful instruction set and still remain compatible with most existing hardware. The functional division of processing allows the 8088 a speed advantage by performing* fetch *and* execute *concurrently.*

all. In fact, my IMSAI computer's front panel does not meet the standard either.

A Solution

Intel's 8088 microprocessor is a remarkable machine. By combining a 16-bit execution unit with an 8-bit bus interface, the 8088 can represent the best of both worlds for many users. (See figure 1.) In particular, the 8088 allows you to reap the benefits of a powerful new architecture while preserving your investment in 8-bit hardware. In addition, many data-handling-oriented applications (such as intelligent terminals, data concentrators, and small business computers) are more naturally implemented with a machine that communicates using 8-bit characters.

New Architectures

The microprocessor revolution is fascinating because it represents a microcosm of the computer revolution. In the last 5 years we have seen computers on silicon follow the footsteps of 30 years of computing history. The effort of the computing pioneers has not been in vain, for it has served to chart our course.

Consider current VLSI (very large scale integration) processing technologies. Semiconductor manufacturers have the capability of placing 30,000 transistors on a chip of silicon today, with as many as 100,000 in the near future. Now imagine a second-generation mainframe computer of the 1960s. It fills an air-conditioned room and consists of large metal boxes and massive power supplies. Inside some of the metal boxes are large racks filled with circuit cards. These circuit cards are covered with transistors, resistors, and capacitors. Today, the computing equivalent of these metal boxes is a small group of integrated circuits.

The user may be initially impressed by the complexity of the computer being used, but he will ultimately judge the machine on the basis of its power and ease of use; therefore, the challenge for the manufacturers is not as simple as maximizing the number of devices. The problem is designing microprocessors that respond to the needs of the user.

The high-performance solution is to implement mainframe architectures that contain tried and proven virtues. Concepts like *attached coprocessors, concurrent I/O processing, pipelining, memory segmentation* and *hardware mathematical operations* are being adopted and put on silicon. When I say the architecture of the 8088 is "new and revolutionary," I am really saying that the day of the "mainframe-on-a-chip" has arrived.

The Best of Both Worlds

The 8088 contains two processors in its 40-pin package. One is called the EU (execution unit) and the other is the BIU (bus-interface unit). The BIU is optimized for communicating with the rest of the computer system, while the EU is optimized for executing programs.

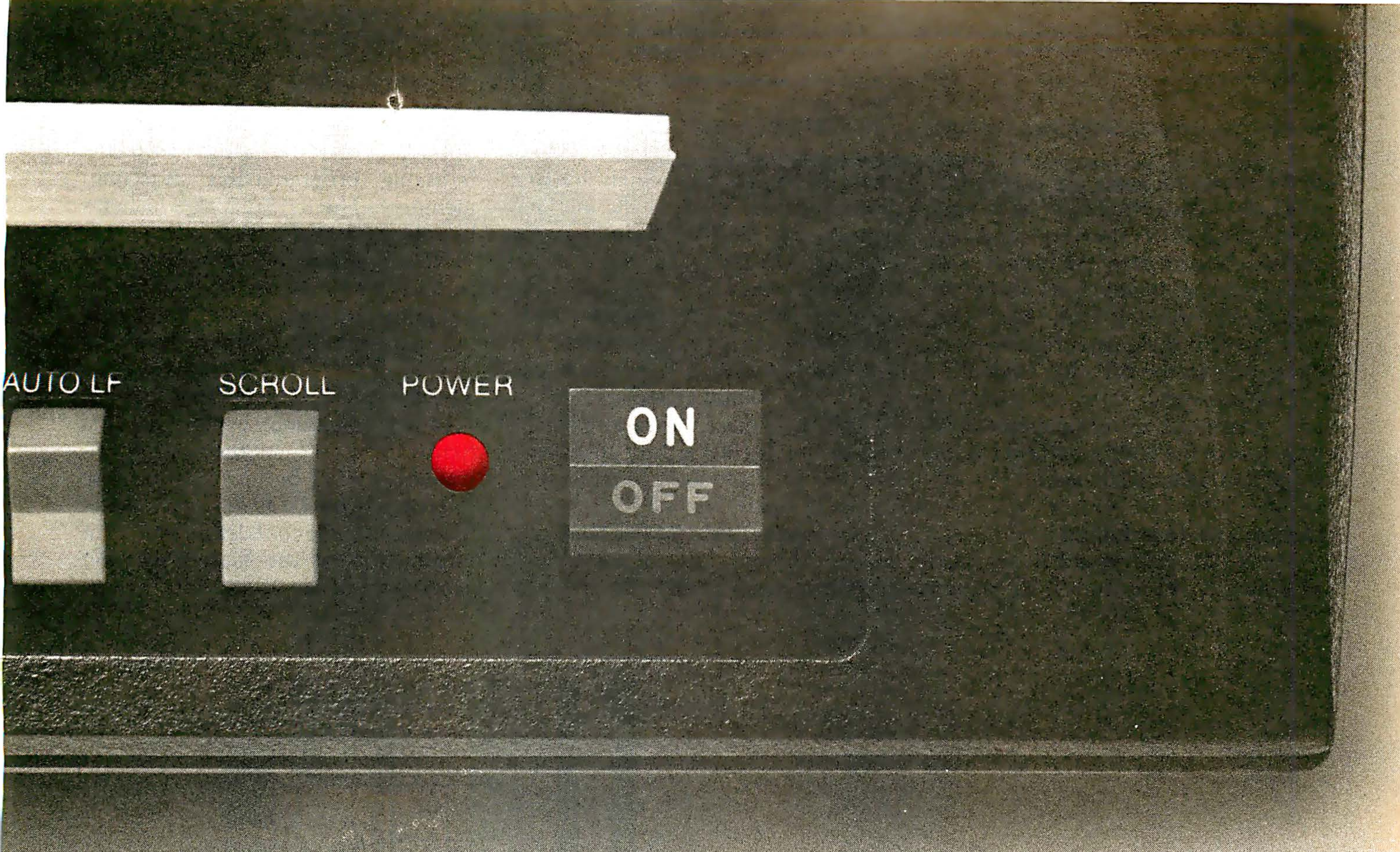
The EU most closely resembles what is conventionally considered the processor; it contains the working registers, the status flags, and the ALU (arithmetic/logic unit). As its name implies, this is where programs are executed.

The EU of the 8088 is the same as the one in the 16-bit 8086 processor. All the registers (twelve of them) are 16 bits wide, though some of them can be treated as two separate 8-bit registers by the programmer. In addition, all math operations (addition, subtraction, multiplication and division) can utilize 16-bit operands.

The 8-bit BIU manages much of the work associated with the address, data, status, and control bus interfaces. The BIU of the 8088 uses an 8-bit data bus for receiving and transmitting data, as opposed to the BIU of the 8086, which uses a 16-bit data bus. An example of the bus-handling optimization of the BIU is that the speed requirements placed on the rest of the system (ie: memory and I/O devices) are very easy to deal with. An 8088 running at 5 MHz can use relatively slow memories (ie: 450 ns access time) with no wait states. Save those old, slow memory boards.

The connection between the BIU (which fetches and stores data) and the EU (which processes the data) is the *queue* or *pipeline*. The BIU keeps the pipeline filled with instructions fetched from memory, while the EU draws instructions from the queue as it needs them.

In less sophisticated computers, the rest of the system (especially memory) might sit idle, waiting for the processor to finish a long instruction. To eliminate this waste of



Diablo printers spend more time in this position.

A printer isn't much good if it can't do the job when it's needed.

That's why, at Diablo, we don't just design printers that work. We design printers that keep on working. In fact, we make them so reliable, you can just open the carton, plug in and play.

Diablo offers the widest range of reliable printers and options to give the flexibility you need. Which stands to reason. After all, we pioneered the daisy wheel technology and we're still the leader in it.

So if your printers spend too much time in the "off" position, you know what to do.

Switch.

Diablo Systems

XEROX

system resources, the BIU of the 8088 will fetch more information and put it in the queue for later use by the EU. Similarly, when the BIU tries to read some extra-slow memory and encounters a wait state, the EU can continue reading instructions from the queue and executing them. All the EU ever "sees" is the queue, regardless of differences in the BIU that feeds it.

This powerful internal architecture, combined with the simple 8-bit I/O, makes the 8088 a natural for the S-100 and other 8-bit buses.

Design and Interfacing

My S-100/8088 board is designed as a simple, yet powerful, base computer with the support logic necessary to interface to the S-100 bus. I will explain the design accordingly by first discussing the design of the minimal system, and then the techniques for interfacing to the S-100 bus.

Several years ago it would not have been uncommon to overhear: "My computer's got a microprocessor, 2 K bytes of EPROM, 1 K bytes of programmable memory, and a couple of I/O ports." Today, the same machine can be created using four integrated circuits. In fact, such a system is shown in figure 2.

This system uses a 5 MHz 8088 processor, driven by an 8284 clock generator, with an 8185-2 1-K-by-8-bit static memory circuit and an 8755A-2 2-K-by-8-bit EPROM (erasable programmable read-only memory). The 8755A-2 also includes two 8-bit parallel ports.

Notice how simple the basic system is. Each part was designed with compatibility in mind, so the interfacing task is essentially "connect the dots."

The 8088 Microprocessor

In the following section, detailed hardware aspects of these key components will be discussed. My reference is Intel's *8086 Family User's Manual*, which contains a wealth of information on the 8088, 8086, and other high-performance members of

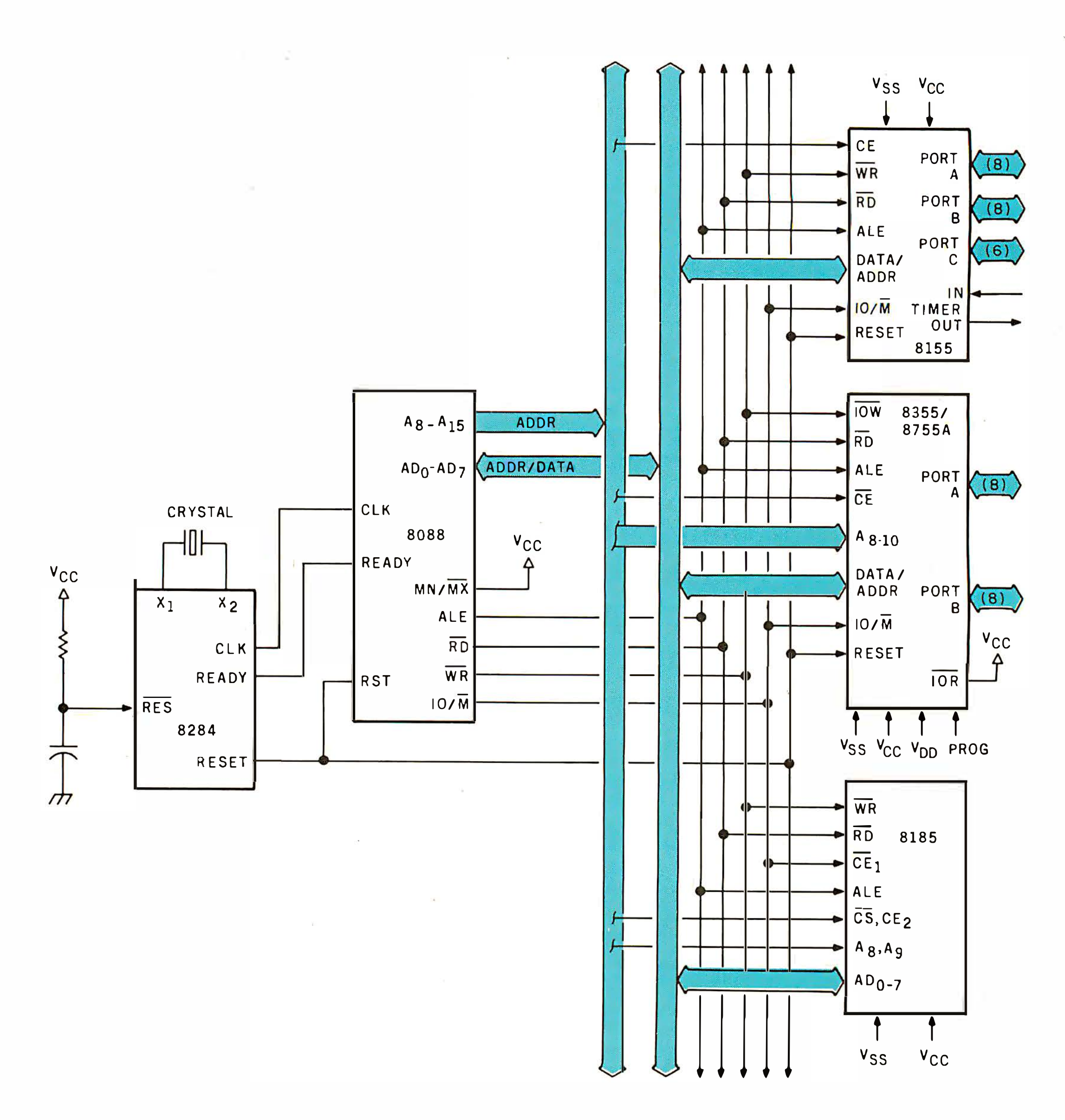
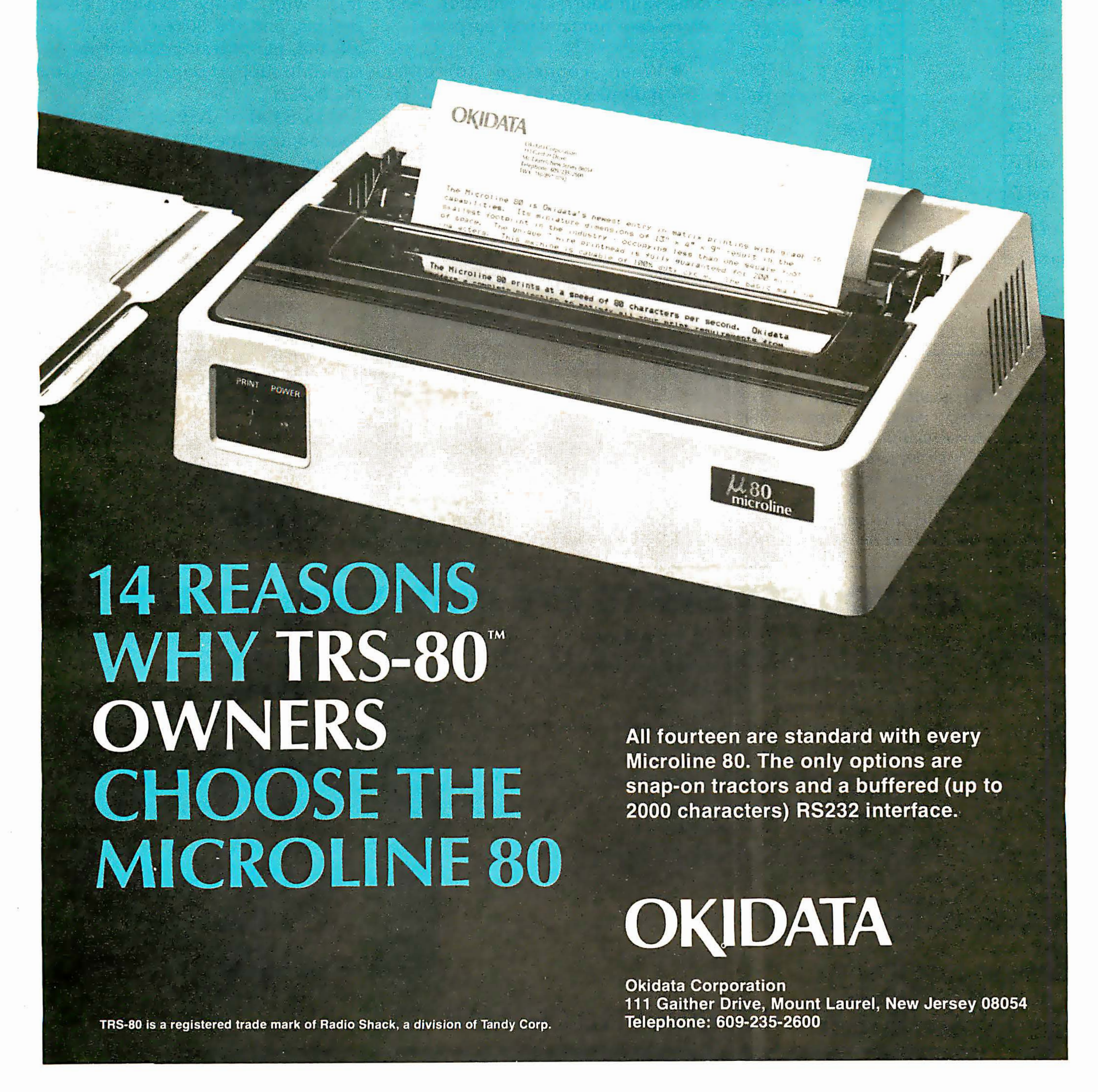


Figure 2: *A minimum system is possible with the 8088 family using only four dual-in-line packages. This system uses a 5 MHz 8088 central processor, driven by an 8284 clock generator. An 8185-2 1-K-by-8-bit programmable memory and an 8755A-2 2-K-by-8-bit EPROM provide system memory and two 8-bit parallel I/O ports. Active-low signals are shown in the figures using the overbar notation, rather than asterisks.*

1. Outlasts every competitor—200,000,000 character head warranty
2. No duty cycle limitations—even in demanding business applications
3. Professional print quality—9 x 7 matrix
4. Rugged business use construction—metal chassis—two motors
5. 80 characters per second
6. Upper and lower case—full 96 character ASCII set
7. Double width characters
8. Connects directly to TRS-80,™ APPLE® and other computers
9. Block graphics—64 shapes for charts, graphs, diagrams
10. Friction and pin feed
11. Plain paper—up to 3 parts
12. 6 and 8 lines per inch—program controlled paper savings
13. 80 and 132 columns—program controlled
14. Price—the best value in the industry. Call or write today for the name of your local Microline 80 dealer.



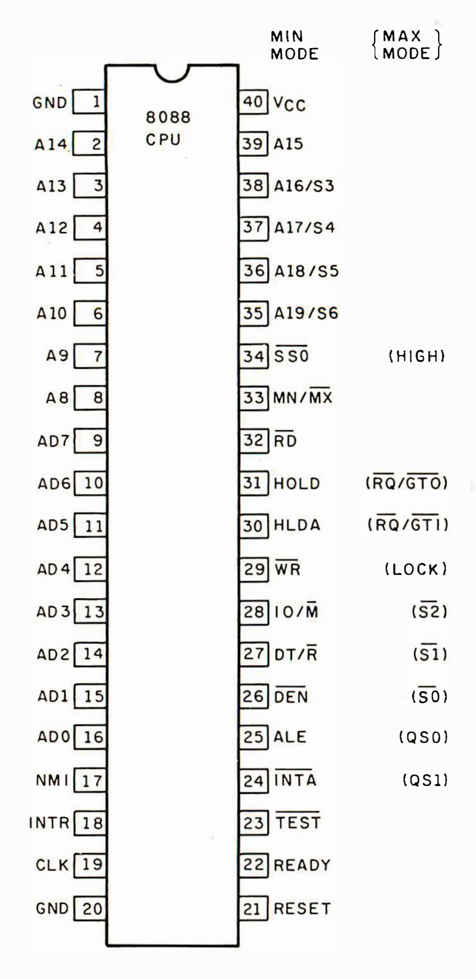


Figure 3: *The pinouts assigned to the 8088 microprocessor package. Notice that many pins serve dual functions depending on the* mode *selected (either* minimum *or* maximum*). Maximum mode is designed to facilitate concurrent processing, using the I/O processor and arithmetic processor also available in the 8088 family.*

the family. See figure 3 for the 8088 pinouts.

The following paragraphs describe the function of the 8088 pins:

AD0 thru AD7: These form the time-multiplexed address and bidirectional data bus. In other words, they sometimes contain address information (A0 thru A7) and other times contain data (D0 thru D7). The obvious benefit of multiplexing is that eight fewer pins are needed on the package.

ALE (Address Latch Enable): The 8088 asserts ALE whenever the multiplexed address/data bus contains valid address information. ALE serves two fundamental purposes.

- When connected to other multiplexed-bus components (as in figure 2), ALE is a signal to them that the processor has address information on its address/data bus.
- We may want to demultiplex the bus—in other words, the rest of the system may want to see a separate address bus and a separate data bus (the S-100 standard requires two separate buses). ALE can be used to *strobe* address information into a *latch* (hence the "latch enable" part of its name) (see figure 4).

A8 thru A15: These are address lines; they are not multiplexed.

You may note that the multiplexed bus and many of the following hardware-interface facets of the 8088 are the same as those of the popular 8085A. The 8088 is upward compatible with many existing 8085A designs, and the 8088 can easily use all the peripheral components designed to support both the 8080A and the 8085A

A16/S3 thru A19/S6: The upper four address lines (A16 thru A19, also known as S3 thru S6) extend the addressing capability of the 8088 to 1 megabyte. This is a very real perfor-

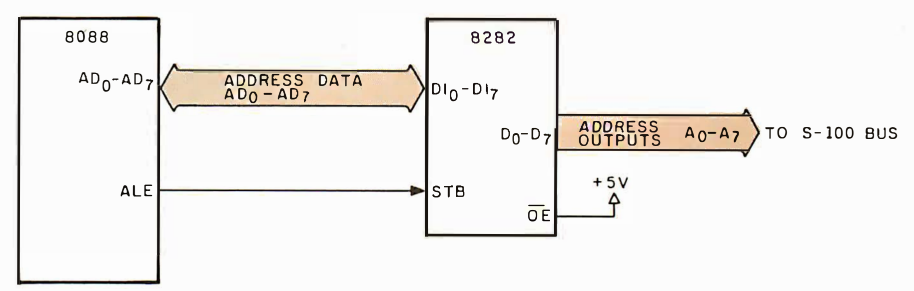


Figure 4: *The ALE signal from the 8088 microprocessor is used to latch address information into an 8282 buffer. The buffer output is demultiplexed address information which has been separated from data that appears on the same pins.*



every smart computer needs an SD SYSTEMS Heart.
We design and manutacture a complete line of industry compatible microcomputer boards and kits that can serve as the heart of your system. All are S-100 Bus compatible and use the Z80 microprocessor.
MPC-4 —This SD Systems exclusive is a multi port controller which uses the Z80 for multi-user operations offering four serial RS-232 I/O channels.
SBC 100/200 —A 2.5/4 megahertz range of single board computers which are effective standing alone or combined with the complete SD board range.
ExpandoRAM I/II —For use with 250/200 nanosecond RAM, these high density boards offer 16 to 64K memory; the ExpandoRAM II can achieve RAM capacities up to 256K using 64K chips.
Versafloppy I/II —A floppy disk controller for up to four drives, supporting single/double density and single/double-sided disk formats.
VDB-8024 —A full function visual display board with a Z80 controller that adds display capabilities to your system.
Prom 100 —A specialty board of SD Systems which allows you to program 2708/2716/2732 proms.
Z-80 Starter Kit —A low-cost entry into the world of microcomputers designed primarily for education and experimentation.
SD SYSTEMS
P.O. Box 28810 • Dallas, Texas 75228 • 214-271-4667 • Telex 6829016
NOW YOU CAN SAVE $25 PER BOARD*
when you purchase any SD Systems microcomputer board from participating SD Systems dealers listed below. *Offer expires 10/31/80
ADVANCED COMPUTER PRODUCTS, INC.
Irvine CA • 714-558-8813
ANCRONA
Culver City CA • 213-641-4064
THE COMPUTER MART
Waltham MA • 617-889-4540
COMPUTER PRODUCTS STORES
Springfield IL • 217-528-0027
CUSHMAN ASSOCIATES
Wilmington DE • 302-995-6733
DAL-COMP
Dallas TX • 214-350-6895
FUTURE ELECTRONICS
Natick MA • 617-237-6340
JADE COMPUTER PRODUCTS
Hawthorne CA • 800-421-5500
MARK GORDON COMPUTER
Cambridge MA • 617-491-7505
MINI MICRO MART
Syracuse NY • 315-422-4467
PRIORITY ONE
Sepulveda CA • 800-423-5633 or 213-894-8171
S-100
Clark NJ • 201-382-1318
Q.T. COMPUTER SYSTEMS, INC.
Lawndale CA • 800-421-5150 (ex. CA) or 213-970-0952
For complete product information, send for SD Systems' board and kit brochure (BK-101).

mance improvement over most 8-bit processors (usually limited to a 64 K-byte address space). These address lines are multiplexed with status information. During the early part of a bus cycle (T1, the first clock period of the four-clock bus cycle), a valid address is present. Then from clock cycles T2 to T4, each of these pins contains status information as follows:

- S6: This signal is always low.
- S5: This signal reflects the state of the EU's interrupt-enable flip-flop. If this signal is high, it indicates that the processor can accept interrupts. If it is low, interrupts are currently disabled.
- S3 and S4: These two pins can encode four possible states. These states reflect the segment register used in forming the address for the current bus cycle. (See table 1.) This information can be used for monitoring program execution or for analyzing program performance. There is also the potential for implementing a memory *bank-switching scheme*, where the two lines are used to choose one of four areas (banks) of memory.

MN/MX*: Reflecting the needs of different users, the 8088 can be operated in two different modes. If MN/MX* is high, the processor is in *minimum* mode; if this input is low, the processor is in *maximum* mode. Depending on the mode (*min* or *max*), certain pins on the processor will serve different purposes. In *min* mode the processor is responsible for generating all bus-control signals. In *max* mode, control signals are generated by an 8288 bus controller.

The control signals put out by the 8088 in *min* mode are then replaced with other signals that facilitate the design of higher-performance (and generally more expensive) systems. These *max* mode signals include a hardware *bus lock*, *queue status* information and the implementation of a memory access *request/grant* protocol used in multiprocessing.

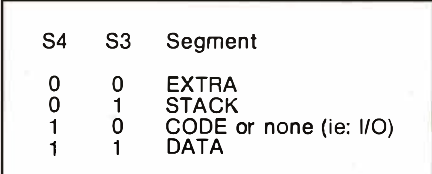
The *max* mode gives a computer the ability to use multiple processors (eg: an 8088 processor with an 8089 concurrent-I/O processor and an 8087 ultra-high-performance numeric-data processor). Note: both *min* and *max* modes allow the 8088 to address the full megabyte of memory.

My S-100/8088 board is implemented in *min* mode, so when a signal that differs for *min* or *max* mode is defined, the *min* mode definition will be used.

RD*: This is the general-purpose read signal that latches data from memory or an I/O device (the device involved depends on the state of IO/M*) into the 8088.

WR*: This is the general-purpose write signal. The 8088 uses WR* to output information to memory or I/O devices.

IO/M*: This line indicates whether the processor is communicating with I/O devices or



S4	S3	Segment
0	0	EXTRA
0	1	STACK
1	0	CODE or none (ie: I/O)
1	1	DATA

Table 1: *Possible interpretations of information on pins S3 and S4 of the 8088. Each of the four states is associated with the segment register that helped form the current address.*

"Our inventory is our existence. Think we'd trust it to anything less than Scotch® Brand Diskettes?"

Don Stone, President, Mass. Auto Supply Company, Inc., Boston, Mass.

Scotch Diskettes are the diskettes you can depend upon with the information *your* business depends upon.

Each one is tested and certified error-free before it leaves our factory. Because we know nothing less than perfection is acceptable for *your* vital business data.

Scotch Diskettes are available in regular or mini sizes, compatible with almost any system.

To find out where you can purchase Scotch Diskettes, call toll free: 800-328-1300. (In Minnesota, call collect: 612-736-9625.) Ask for the Data Recording Products Division. In Canada, write 3M Canada Inc., London, Ontario, N6A 4T1.

If it's worth remembering, it's worth Scotch Data Recording Products.



3M

Circle 37 on inquiry card.

memory.

DEN* and DT/R*: The data enable (DEN*) and data-transmit/receive (DT/R*) signals are primarily for use with the 8286 and 8287 bus transceivers. These devices serve to buffer the information going to or from the 8088 processor. DT/R* configures the transceiver for either the transmission or reception of data. DEN* is used to enable the 8286 or 8287 at the correct time. Since my system does not use these transceivers, DEN* and DT/R* are not used.

INTR: This interrupt-request line is the general-purpose interrupt input. The ability to receive interrupts can be masked via software using the clear interrupts (CLI) instruction, (similar to the 8080A DI instruction). If interrupts are not disabled, the processor will vector (ie: jump) to an appropriate interrupt-handling routine (see INTA*, below).

INTA*: Upon receipt of an INTR instruction, the 8088 will begin an (INTA*) *interrupt-acknowledge* sequence. The INTA* signal is used to read an interrupt *type vector.* Without going into details, this type vector is used by the 8088 to determine the actual address of the appropriate interrupt routine. Commonly, INTA* and INTR are connected directly to an 8259A programmable priority-interrupt controller, allowing an easy implementation of powerful and flexible interrupt-driven systems.

NMI: The nonmaskable interrupt line NMI is an input similar to the more general INTR except for two fundamental differences:

- Receipt of NMI does not generate an INTA* sequence; rather, a fixed location (stored at hexadecimal address 08) is immediately vectored to.
- NMI interrupts cannot be masked (ie: via the CLI instruction, as for INTR); NMI interrupts are usually reserved for catastrophic events such as imminent power failure or recurrent bus errors.

READY: READY is an input to the 8088 which indicates that an addressed memory or I/O device is currently capable of completing an input or output data transfer. The 8088 will enter and execute *wait states* (idle clock cycles with all control and address lines valid) until READY is brought high. This signal is normally used to allow operation with slow memories or I/O devices. It is also handy for implementing hardware single-step capability via a front panel switch.

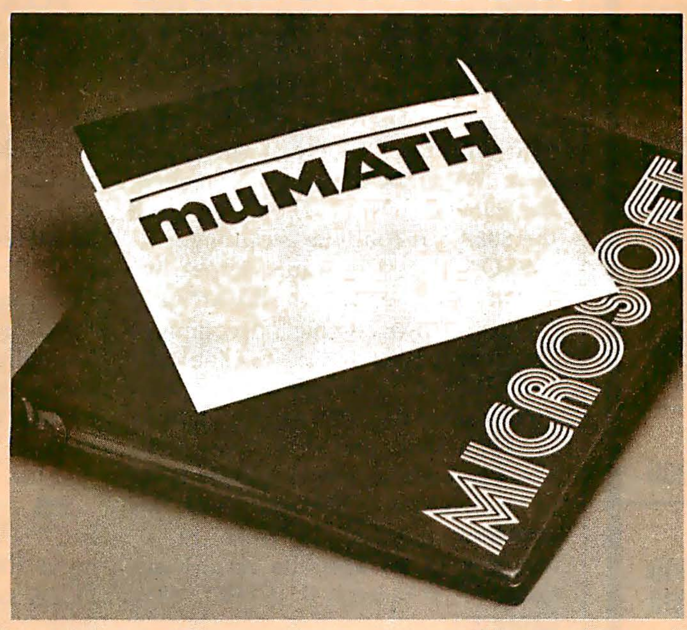
TEST*: This unique input line, in combination with an associated software instruction, yields a powerful hardware/software debugging capability. It works like this: when the 8088 executes a WAIT (wait for TEST*) instruction, it immediately examines the state of the TEST* input line. If TEST* is low, execution simply continues with the next instruction; however, if TEST* is high, the processor waits in an idle state. TEST*, combined with the above mentioned READY-signal-based single-stepping capability, provides a powerful debugging aid that I have exploited in my design.

Another use for TEST* is the synchronization of concurrent processing. An example will serve to explain this more fully.

PROBLEM.

INT(X^N+X*SIN(X^2),X)

SOLUTION.



Surprised? You should be. Because until now, no software could solve anything but the most basic arithmetic problems without a series of complicated steps.

A big disadvantage? If you use a microcomputer for scientific, educational or engineering applications, you bet it is. That's why Microsoft has come up with a solution of its own. muMath.

muMath is a symbolic math package you'll recognize immediately as a major advance in microcomputer software.

muMath lets you efficiently and accurately perform the most complex mathematical operations: Exact, infinite precision rational arithmetic. Unbound variables. Complex expressions (even equations may be included). Exact solution of algebraic equations. Plus logarithmic, exponential and trigonometric simplifications and transformations.

That's right. It does in an instant what took you years to learn at school. Rational arithmetic. Algebra. Trigonometry. Transcendental functions. Symbolic differentiation (including ordinary and partial derivatives.) Symbolic integration of indefinite and definite integrals. Matrix arithmetic and algebra.

Trigonometric simplification? But of course. Just type: ?SIN (2*Y) * (4*COS(X)^3 −COS(3*X)+SIN(Y)*COS (X+Y+#P1)−COS(X−Y)); Then instantly muMath returns: @4*SIN(Y)*COS(X)*COS(Y).

Adding fractions? Need you ask? ?1/3+5/6+2/5+3/7; @419/210.

muMath is written in muSIMP, which is included in the muMath package.

muSIMP is an applicative, recursive language, ideal for describing complex mathematical concepts.

Because of its highly interactive nature and hierarchical structure, muMATH is an excellent math teaching device, from simple arithmetic to calculus.

muMATH is currently available for the CP/M® operating system.

The complete system, including muMATH and muSIMP on disk and documentation is $250. Runs under CP/M.

Just what you need? We thought so. Shoot some questions at us about muMATH. We have all the answers.

Also new from Microsoft: the muLISP interpreter for CP/M. An efficient and reliable LISP system fully capable of supporting serious artificial intelligence efforts. $200.

CP/M is a registered trademark of Digital Research.

MICROSOFT

10800 NE Eighth
Suite 819
Bellevue, WA 98004
206-455-8080
Telex 328945

We set the standard.

Imagine a *max*-mode 8088 system that also utilizes an independent 8089 I/O processor. A common occurrence will be the 8088 issuing a "command" to the 8089 to perform some I/O function (such as reading from or writing to a disk, or printing on a printer). While the 8089 is doing this, the 8088 can continue executing the user's program (resulting in concurrent or simultaneous processing).

However, in some cases, the 8088 must wait for the 8089 to finish its I/O task. For example, the user's program may not be able to continue processing until data is retrieved from a disk. In this case, the 8088 will command the 8089 to perform the read operation and will then execute a WAIT instruction. Meanwhile, the 8089 pulls the 8088's TEST* input high until the I/O operation is complete. When the operation is finished, the 8089 will bring TEST* low and the 8088 can continue executing.

SSO*: This is a status output line which, combined with IO/M* and DT/R*, allows complete decoding of the current 8088 status. (See table 2.)

RESET: A high-logic state on this input causes the 8088 to terminate its present activity and restart execution. The CS (code-segment) register is set to hexadecimal 0FFFF and the IP (instruction pointer) is reset to 0, resulting in an absolute restart address of hexadecimal 0FFFF0. (See figure 5.)

CLK: This is the clock input to the processor and is normally driven by the 8284 clock generator. It is a 5 MHz, 33% duty-cycle signal.

The 8284

The 8284 clock generator is used to generate an optimal clock signal for the 8088 and condition some of the basic processor-control signals. (See figure 6.) Some of its functions are more directed towards *max*-mode multiprocessing bus control and will not be discussed here.

The following paragraphs describe the functions of the 8284 pins.

X1 and X2: These pins are attached to the crystal that generates the fundamental clock frequency. Note that the crystal frequency is three times the desired operating frequency (ie: 15 MHz for a 5 MHz 8088). It is also recommended that a 3 pF to 10 pF capacitor be connected in series with X2.

CLK: This is the optimized clock output that is directly connected to the 8088 CLK input.

PCLK and OSC: The peripheral clock line (PCLK) is a TTL (transistor-transistor logic)-level, 50% duty-cycle clock output of the 8284 with a frequency of half that of the CLK output. The OSC line is similar but operates at the crystal frequency (eg: a 15 MHz crystal gives a 15 MHz OSC signal, which drives a 5 MHz 8088 CLK signal and a 2.5 MHz PCLK signal).

F/C*: The frequency/crystal select line allows generation of a clock signal using either a crystal or an external frequency input (see EFI below). Since I use a crystal, F/C* is tied low in my system.

EFI (External Frequency In): If F/C* is high, the 8284 will use the EFI input line to generate the CLK and PCLK signals. Once again, the CLK output will be one-third the frequency present on EFI (OSC and PCLK act the same too).

AEN1*, AEN2*, RDY1, and RDY2: These signals are primarily used in multiprocessor systems; however, I do use RDY2 to condition the system READY signal for use by the 8088. AEN1*, AEN2* and RDY1 are not used in my system.

READY: As mentioned previously, this 8284 output line is a conditioned and synchronized reflection of the in-

IO/M*	DT/R*	SSO*	Status
1	0	0	Interrupt Acknowledge
1	0	1	Read I/O port
1	1	0	Write I/O port
1	1	1	Halt
0	0	0	Code Access
0	0	1	Read Memory
0	1	0	Write Memory
0	1	1	Passive (idle)

Table 2: *The status of the 8088 processor is completely encoded by the three signals above.*



"Look at what ONE Microcomputer, FAMOS,™ & a bunch of "dumb" terminals can do TOGETHER!"
WORD PROCESSING PROGRAM REENTRANT
BASIC BUSINESS PROGRAM
PASCAL BUSINESS PGM
WORD PROCESSING PROGRAM REENTRANT
COBOL BUSINESS PROGRAM
WORD PROCESSING PROGRAM REENTRANT
BASIC PROGRAM DEVELOPMENT
MEMORY RESIDENT REENTRANT RUN-TIME SYSTEM (24 KBytes)
DYNAMIC MEMORY ALLOCATION
DYNAMIC TASK ALLOCATION
DYNAMIC BANK ASSIGNMENT
DEVICE INDEPENDENT FILE SYSTEM
MULTI-TASKING MULTI-SESSIONING
AUTOMATIC RECORD LOCKOUTS
DATA FILES
Another *@!¶# CRASH!!! I should have used FAMOS!!!
DATA FILES
DATA FILES
NEW BASIC COMPILER
OPTIMIZED CODE
AUTO INTEGER REPRESENTATION
VARIABLE PRECISION (4-18)
MULTIPLE KEY ISAM
REENTRANT OBJECT & RUN-TIME
SCREEN HANDLING UTILITY
8080, Z80 VERSIONS AVAILABLE
BATCH OPERATIONS UNDER BASIC
Over 500 users.... APPLICATIONS AVAILABLE
MVT MICROCOMPUTER SYSTEMS INC.
9241 RESEDA BLVD., SUITE 203, NORTHRIDGE, CA 91324
Phone: (213) 349-9076 TWX 910 493-2291 MVT NTGE
FAMOS,™ System Software with unique file integrity.... for the OEM & Manufacturer.

puts at RDY1 and RDY2 and is tied directly to the 8088 READY input.

RES*: The reset-in signal (RES*) is an 8284 input line that is connected to the system RESET line (through a front-panel switch). *Power-on-reset* as well as proper input conditioning are obtained by the use of an appropriate resistor/capacitor timing network.

RESET: This is the conditioned reset output of the 8284 (based on the RES* input) and is tied directly to the 8088 RESET input line.

The 8755A-2 and the 8185-2

Looking at the 8755A-2 and 8185-2 pinouts (see figures 7a and 7c), we immediately notice that a lot of the signals are common to the 8088 and have already been discussed. AD0 thru AD7 (and other address lines), ALE, IO/M*, RD*, WR* and RESET are all used. This illustrates what I said earlier about the "connect the dots" ease of design using these multiplexed-bus components. Simply connect the 8088 pins AD0 thru AD7 to 8755A-2 pins AD0 thru AD7 and the 8185-2 pins AD0 thru AD7. Then connect the 8088 ALE pin to the 8755A-2 ALE pin and the 8185-2 ALE pin, etc.

The 8755A-2 is a 2-K-by-8-bit EPROM (erasable programmable read-only memory) much like the familiar 2716. The "−2" suffix means that it can run reliably at 5 MHz, compared to the 3 MHz rating of the standard 8755A. Two useful enhancements are the addition of two independent 8-bit bidirectional parallel I/O ports and the use of the multiplexed bus; these make the system-design task much easier. The 8755A-2 is programmed in much the same way as the 2708 and the 2716, but differences do exist. Also, most EPROM programmers do not have 40-pin sockets. I hope some enterprising experimenter will develop an 8755-2 "byteburner" for the S-100 bus. This might be as simple as a "pin-scrambler" adapter (with a little extra circuitry) for existing EPROM programmers.

The 8185-2 is a 1-K-by-8-bit static memory circuit that is quite easily interfaced to the multiplexed bus. The byte-wide organization, low power and small physical size (only eighteen pins) make this a natural for minimal systems.

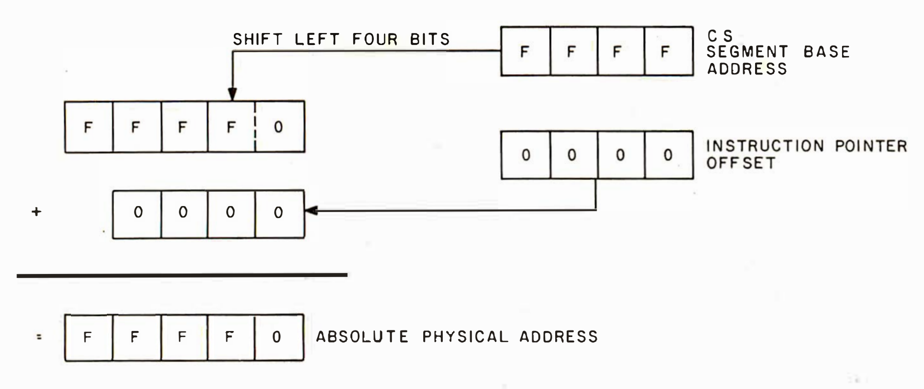


Figure 5: *Calculation of the reset address on the 8088. The 8088 reset address is derived from the code-segment register, which is set to hexadecimal 0FFFF, and the value in the instruction pointer, which is reset to 0.*

A Base on Which to Build

The front panel on my IMSAI computer has many functions that are irretrievably tied to the 8080A instruction set. As an example, when I enter an address on the front panel address switches and push the Examine switch, the front panel "jams" an 8080 JMP (jump, hexadecimal C3) instruction onto the processor's data bus; allows the processor to execute the jump while jamming the address I entered on the switches onto the data

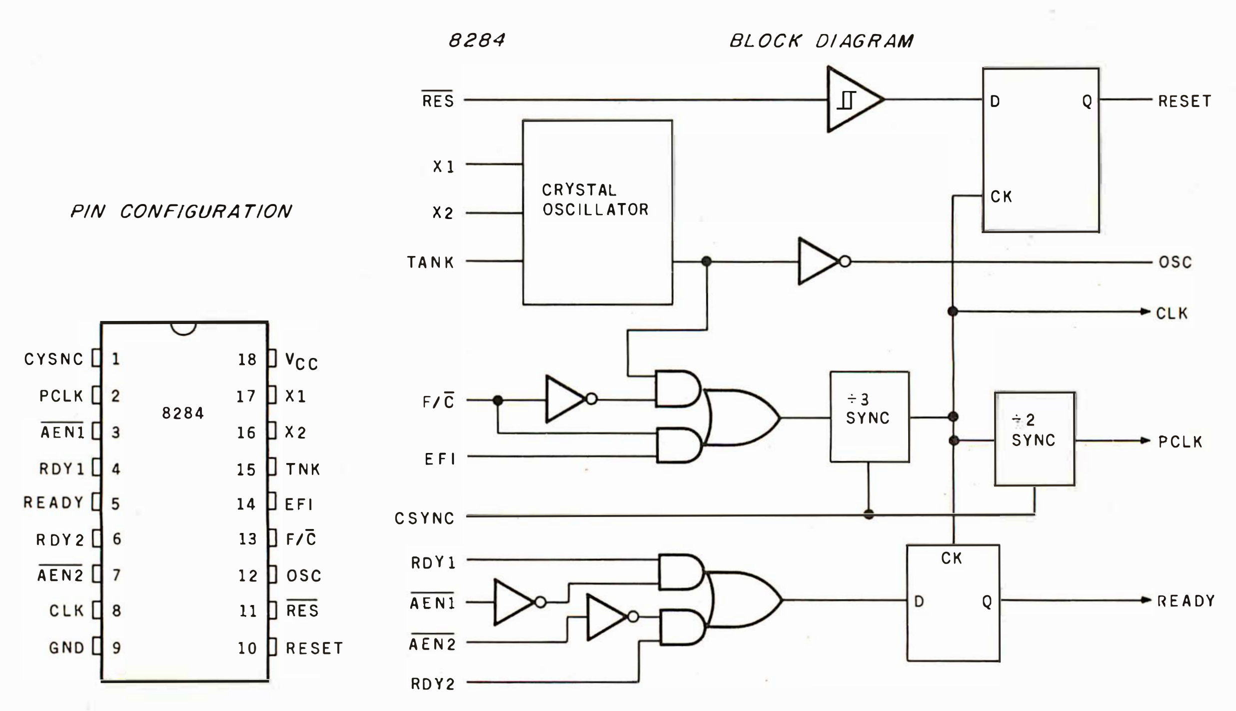


Figure 6: *The 8284 clock generator. This device provides an optimum clock signal and serves to buffer and condition some of the basic processor signals. Figure 6a shows the pin labeling for the device, while figure 6b shows a block diagram of its internal structure.*

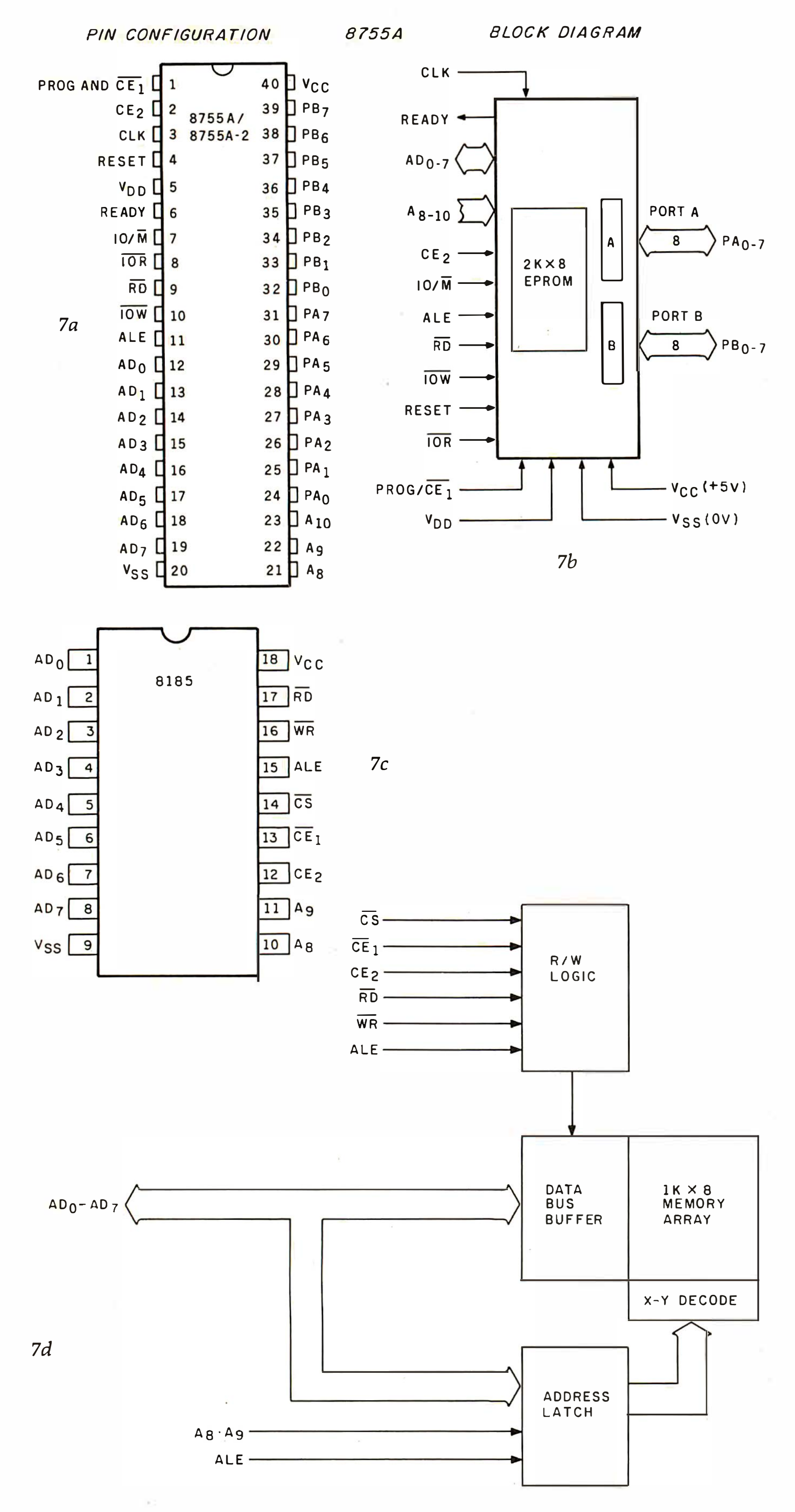


Figure 7: *Pinouts and block diagrams of the 8755A-2 EPROM (figures 7a and 7b) and the 8185-2 user programmable memory (figures 7c and 7d). These circuits were designed specifically to work with the 8088 multiplexed bus lines; they provide two 8-bit parallel I/O ports without any additional hardware.*

bus; and finally stops the processor once the jump is completed.

Similarly, for Examine-Next and Deposit-Next functions, the front panel jams and executes a NOP (no-operation, hexadecimal 00) instruction to move on to the next location.

The JMP and NOP instructions for these switch functions are hard-wired into the front-panel circuitry; circuit traces must be cut to change them. Since the operation codes for the 8088 are completely different, every attempt at front-panel operation would produce bizarre results. Other difficulties include the two's-complement representation of 8088 JMP addresses and the IMSAI's use of S-100 control signals that have been outlawed by the IEEE standard.

Because of these difficulties, I decided to base my 8088 project on a different S-100 system. Fortunately, I was able to scrounge a vintage BYT-8 S-100 box at the local electronic flea market for a good price. The box did not contain any circuit boards, but the metal panel on the front did have cutouts for various LEDs (light-emitting diodes) and switches, which I used to implement a minimal front panel (see photo 1). While I agree with the principle of turnkey systems, which have only power and reset switches, a front panel is a useful tool for debugging any new hardware design. The front panel is a "window" into the machine, one that is needed in case the system does not work perfectly the first time.

Next Month

Next month's installment will cover some of the more interesting aspects of interfacing to the S-100 bus, including the amount of TTL "glue" necessary to emulate the control and status signals of the S-100 standard and the construction of the actual processor board. ■

References

Both the 8086 and 8088 microprocessors have been discussed by Steve Ciarcia in "Ciarcia's Circuit Cellar" articles in BYTE, as follows:

1. "The Intel 8086", November 1979 BYTE, page 14.
2. "Ease Into 16-Bit Computing: Get 16-Bit Performance from an 8-Bit Computer", March 1980 BYTE, page 17.
3. "Ease Into 16-Bit Computing, Part 2: Examining a Small Multi-User System", April 1980 BYTE, page 40.

Look what's happened to HIPLØT™

DMP-3 $1,250*

DMP-2 $1,085

DMP-4 $1,385*

DMP-6 $1,850*

DMP-5 $1,685*

DMP-7 1,985*

It's grown into a complete family of quality low cost digital plotters

Circle 42 for literature

Yes, they are UL listed! **

Circle 375 to have representative call

In just two short years, The HIPLØT has become the most popular digital plotter among small systems users. With a record like that, what can we do for an encore? WE'VE INTRODUCED A COMPLETE LINE OF HIPLØTS...with a model suited for just about every plotting application.

The HIPLØT DMP Series is a new family of digital plotters with both "standard" and "intelligent" models available with surface areas of 8½" x 11" (DIN A4) and 11" x 17" (DIN A3). For the user needing a basic reliable plotter, we have the "old standard" DMP-2 (8½" x 11") and the "new standard" DMP-5 (11" x 17"). For those needing a little more capability, there are the DMP-3 (8½" x 11") and the DMP-6 (11" x 17")—both microprocessor controlled and providing easy remote positioning of the X and Y axes (perfect for the OEM). For those who want this intelligence plus the convenience of front panel electronic controls, we've provided the DMP-4 (8½" x 11") and the DMP-7 (11" x 17").

The "standard" plotters come complete with an RS-232-C and a parallel interface. The "intelligent" DMP plotters accept data from either an RS-232-C or Centronics data source. For the "standard" plotters, software is available from our ever expanding "Micrographic Users Group." The "intelligent" HIPLØTs use our exclusive DM/PL™ language which minimizes plot software to a fraction of that normally associated wth digital plotting.

With the new DMP Series, high quality digital plotting can now be a part of your system. It just doesn't make sense to be without this valuable tool when there is a DMP plotter with the plot size, speed and capabilities that are exactly tailored to your specific needs...and your budget.

Prices for the DMP series range from $1,085* to $1,985*. For complete information and descriptive literature, contact Houston Instrument, One Houston Square, Austin, Texas 78753. (512) 837-2820. In Europe contact Houston Instrument, Rochesterlaan 6 8240 Gistel, Belgium 059/277445. For rush literature requests and sales office information, persons outside Texas call toll free 1-800-531-5205.

houston instrument

GRAPHICS DIVISION OF

BAUSCH & LOMB

TM HIPLOT and DM/PL are Trademarks of Houston Instrument

*U.S. suggested retail prices only.
**DMP 2, 3 and 4 UL listed
DMP 5, 6 and 7 UL listing pending

Programming Quickies

Time Your Tape

John O'Flaherty, St Louis Veterans Administration Medical Center, St Louis MO 63125

Recently I was involved in a research program that required long-term recording (eight hours) of physiological data on an analog instrumentation recorder. We needed a quick method of searching the tape for information occurring at certain times. Although a time marker was recorded on one channel, it could not be played back during fast-forward operation. Unfortunately, although the take-up-reel turns counter indexed unique locations on the tape, the readings obtained did not correlate simply with time. Obviously, one turn on a fully wound reel contains at least twice as much tape as one turn on a bare hub.

I developed a computer solution to the problem. Given the diameter of the take-up-reel hub, the length of the tape, and the turns-counter reading at the end of the tape, the program of listing 1 prints a table relating turns-counter reading, elapsed time, remaining time, footage used, and footage remaining.

The method used is simple (now!): the single datum needed is an accurate value for tape thickness *as wound*, and it is found by considering the side of the tape first as a very long, very thin rectangle, and then as a circle. The area of the side of the tape (ie: what is seen as you face the reel on its axis) can be approximated by a linear function of tape thickness:

$$\text{Area} = \text{Tape Thickness} \times \text{Tape Length}$$

or by a nonlinear function of tape thickness:

$$\text{Radius} = \text{Tape Thickness} \times \text{Turns Count} + \text{Hub Radius}$$
$$\text{Area} = \pi \times (\text{Radius})^2 - \text{Hub Area}$$

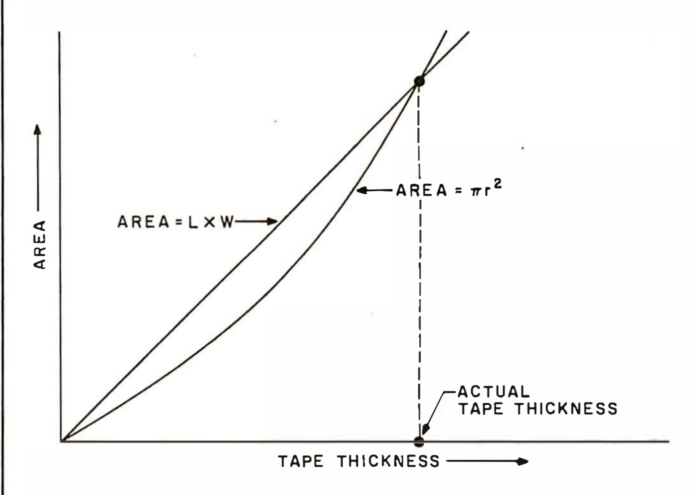


Figure 1: *Area occupied by the side of a given length of tape as tape thickness is changed. The X-axis value at the nonzero intersection of area calculated by two different methods must be the actual tape thickness.*

Lines 30 thru 80 of listing 1 find the intersection of these two functions by iteration for a fully wound reel of tape. (See figure 1.) Then lines 95 thru 230 generate a table by finding area through radius, and length and time from area for turns-counter increments of ten.

It has not been possible to test the routine on the instrumentation recorder yet, but I have applied the method to my own cassette recorder with very good results. For a C-60 cassette, which actually runs 32 minutes, 23 seconds per side, the tape length was precalculated to be (1943 s × 1⅞ ips/12) = 303.6 feet. By carefully disassembling the cassette, the hub diameter was found to be 0.8525 inches (five cassettes from different manufacturers were found to be identical in this respect). The ratio of indicated to actual turns of the takeup reel was found by turning the reel one hundred turns by hand (an index mark helps), and noting the turns-counter reading.

Then the program was run and table 1 (see page 74) was printed, and its accuracy was tested by actually running the tape and noting the times for turns-counter increments of ten.

The test results are printed as the last two columns in the table. As can be seen, the worst case error is 5 seconds, or 0.3% of the total time, which is surprisingly good, in view of tape counters' reputed inaccuracy, and the fact that no empirical trimming was done—the algorithms simply try to represent the physical realities of the situation.

One might also use the formulas above to program a portable calculator to find time for turns count or vice versa, without consulting a table.

Listing 1: *An Applesoft BASIC program for correlating turns-counter readings with time. All documentation statement line numbers end in 5, and they may be ignored when keying in the program.*

```
5  REM SET CONSTANTS & MENTION VA
     RIABLES FOR EFFICIENCY
10 PI = 3.141592654:TW = 2:W = 1:
     TV = 12:DD = .000001:HS = 0:
     TT = 0:ITC = 0:HH = 3600:MM =
     60:HF = 0.5:TC = 0
20  HOME : GOTO 1000
25  REM  FIND ACTUAL TAPE THICKNE
     SS
30  PRINT "CALCULATING TAPE THICK
     NESS AS WOUND..."
35  REM AREA BY PI(R^2) MUST EQUA
     L
40 A1 = PI * ((MTC * TT + HS) ^ T
     W - HS ^ TW)
45  REM AREA BY L*W
50 A2 = ML * TT * TV
60 CR = A1 / A2:TT = TT / CR
65  REM  SO TRY NEW TT TILL IT DO

70  IF  ABS (W - CR) > DD THEN 40

80  PRINT : RETURN
95  REM  GENERATE TABLE
100  FOR ITC = 0 TO MIT STEP 10
```

Listing 1 continued on page 70

A Few Extraordinary Products for Your 6800/6809 Computer

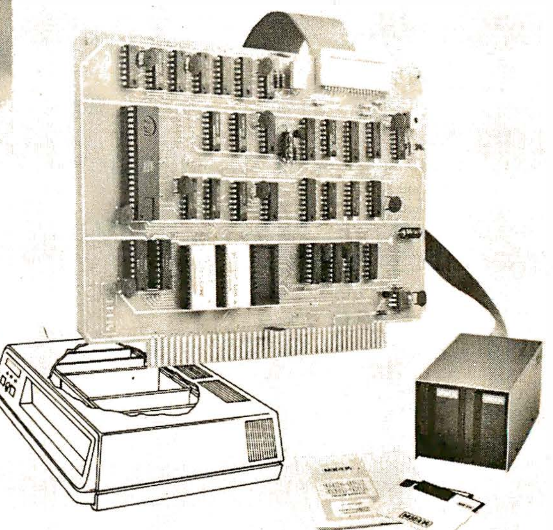
From Percom . . .

Low Cost Mini-Disk Storage in the Size You Want

SS-50 Bus LFD-400™ and LFD-800™ Systems

Percom mini-disk systems start as low as $599.95, ready to plug in and run. You can't get better quality or a broader selection of disk software from any other microcomputer disk system manufacturer — at any price!

Features: 1-, 2- and 3-drive systems in 40- and 77-track versions store 102K- to 591K-bytes of random access data on-line • controllers include explicit clock/data separation circuit, motor inactivity time-out circuit, buffered control lines and other mature design concepts • ROM DOS included with SS-50 bus version — optional DOSs for EXORciser* bus • extra PROM sockets on-board • EXORciser* bus version has 1K-byte RAM • supported by extended disk operating systems; assemblers and other program development/debugging aids; BASIC, FORTRAN, Pascal and SPL/M languages; and, business application programs.



EXORciser Bus LFD-400EX™ -800EX™ Systems*

Versatile Mother Board, Full-Feature Prototyping Boards

Printed wiring is easily soldered tin-lead plating. Substrates are glass-epoxy. Prototyping cards provide for power regulators and distributed capacitor bypassing, accommodate 14-, 16-, 24- and 40-pin DIP sockets. Prototyping boards include bus connectors, other connectors and sockets are optional.

MOTHERBOARD — accommodates five SS-50 bus cards, and may itself be plugged into an SS-50 bus. Features wide-trace conductors. Price: $21.95

SS-50 BUS CARD — accommodates 34- and 50-pin ribbon connectors on top edge, 10-pin Molex connector on side edge. Price: $24.95.

SS-30 BUS CARD — 1¼-inch higher than SWTP I/O card, accommodates 34-pin ribbon connector and 12-pin Molex connector on top edge. Price: $14.95.

The SBC/9™. A "10" By Any Measure.

The Percom SBC/9™ is an SS-50 bus compatible, stand-alone Single-Board Computer. Configured for the 6809 microprocessor, the SBC/9™ also accommodates a 6802 without any modification. You can have state-of-the-art capability of the '09. Or put to work the enormous selection of 6800-coded programs that run on the '02.

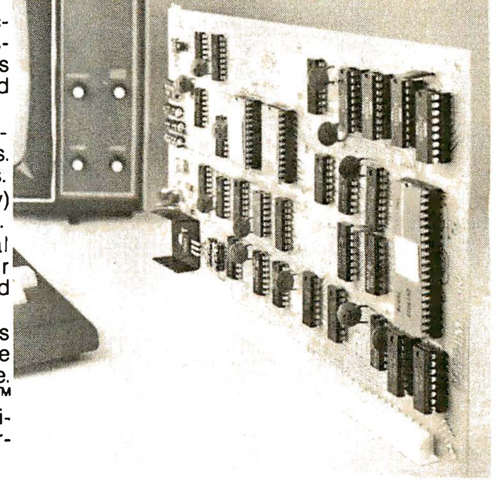
The SBC/9™ includes PSYMON™, an easily extended 1-Kbyte ROM OS. Other features include:

- Total compatibility with the SS-50 bus. Requires no changes to the motherboard, memory or I/O.
- Serial port includes bit-rate generator. RS-232-C compatible with optional subminiature 'D' connector installed. 10-pin Molex connector provided.
- Eight-bit, non-latched, bidirectional parallel port is multi-address extension of system bus. Spans a 30-address field; accommodates an exceptional variety of peripheral devices. Connector is optional.
- Includes 1-Kbyte of static RAM.
- Costs only $199.95 with PSYMON™ and comprehensive users manual that includes source listing of PSYMON™.

The Electric Window™: Instant, Real-Time Video Display Control

Memory residency and outstanding software control of display format and characters make this SS-50 bus VDC card an exceptional value at only $249.95. Other features:

- Generates 128 characters including all ASCII displayable characters plus selected Greek letters and other special symbols.
- Well-formed, easy-to-read 7x12-dot characters. True baseline descenders.
- Character-store (display) memory included on card.
- Provision for optional character generator EPROM for user defined symbols.
- Comprehensive users manual includes source listing of Driver software. Driver — called WINDEX™ — is also available on minidiskette through the Percom Users Group.



™ trademark of Percom Data Company, Inc.
* trademark of the Motorola Corporation.

Prices and specifications subject to change without notice.

PERCOM

PERCOM DATA COMPANY, INC.
211 N. KIRBY GARLAND, TEXAS 75042
(214) 272-3421

Products are available at Percom dealers nationwide. Call toll-free, 1-800-527-1592, for the address of your nearest dealer, or to order direct.

Listing 1 continued:

```
110 TC = ITC * IR
120 R = TC * TT + HS
130 A = PI * (R ^ TW - HS ^ TW)
140 L = A / TT
150 T1 = L / SPD
160 T2 = MXT - T1
170 F1 =  INT (L / TV + HF)
180 F2 =  INT (ML - F1 + HF)
190  PRINT ITC; TAB( 8);:TM = T1:
      GOSUB 300
200  PRINT  TAB( 18);:TM = T2: GOSUB
     300
210  PRINT  TAB( 29)F1 TAB( 35)F2

220  IF CL = W THEN 260
230  NEXT
235  REM  220,240,250 TO CLOSE TA
     BLE NEATLY
240  IF  INT (MIT / 10) = MIT / 1
     0 THEN 260
250 CLOSE = 1:ITC = MIT: GOTO 110

260  END
295  REM  CONVERT SEC TO HR,MIN,S
     EC    AND PRINT
300 TM =  INT (TM + HF)
310 H =  INT (TM / HH):TM = TM -
     (H * HH)
320 M =  INT (TM / MM):S = TM - (
     M * MM)
325  REM  PRETTYPRINTING
330 Q = H: GOSUB 380: PRINT ":";
340 Q = M: GOSUB 380: PRINT ":";
350 Q = S: GOSUB 380
360  RETURN
380  IF Q < 10 THEN  PRINT "0";
390  PRINT Q;: RETURN
995  REM  INPUT NECESSARY INFORMA
     TION
1000  INPUT "HUB DIAMETER(INCH)?
     ";HS:HS = HS / 2
1010  INPUT "TAPE LENGTH LESS LEA
     DER(FEET)? ";ML
1020  INPUT "TURNS COUNT AT END O
     F TAPE? ";MIT
1030  PRINT "TURNS COUNT READING
     FOR"
1035  REM  MTC WILL BE ACTUAL
     TURNS COUNT
1040  INPUT "100 ACTUAL TAKE-UP T
     URNS? ";IR:IR = 100 / IR:MTC
      = MIT * IR
1050  PRINT "1...15/16    IPS"
1060  PRINT "2...1-7/8    IPS"
1070  PRINT "3...3-3/4    IPS"
1080  PRINT "4...7-1/2    IPS"
1090  PRINT "5...15       IPS"
1100  PRINT "6...30       IPS"
1110  INPUT "WHICH TAPE SPEED? ";
     SPD
1115  REM  KLUGE TO FIND SPEED
     FROM TABLE ENTRY
1120 SPD = .9375 * 2 ^ (SPD - 1)
1125  REM  FIND MAX. TIME
1130 MXT = (ML * 12) / SPD
1135  REM  SET START VAL FOR   TT
     AND FIND ACTUAL VALUE
1140 TT = .001: GOSUB 30
1145  REM  PRINT COLUMN HEADS
1150  PRINT "TURNS" TAB( 8)"ELAPS
     ED" TAB( 18)"REMAINING" TAB(
     29)"FEET" TAB( 35)"FEET"
1160  PRINT "COUNT" TAB( 8)"TIME"
      TAB( 18)"TIME" TAB( 29)"USE
     D" TAB( 35)"LEFT"
1170  PRINT
1175  REM  GENERATE TABLE
1180  GOSUB 100
2005  REM TT=TAPE THICKNESS
2015  REM HS=HUB SIZE
2025  REM ML=TOTAL TAPE LENGTH
2035  REM MIT=MAX INDIC. TURNS
2045  REM MTC=MAX ACTUAL TURNS
2055  REM ITC=IND. CURRENT T.C.
2065  REM TC=ACT. CURRENT T.C.
2075  REM IR=ACT./IND. RATIO
2085  REM R,A,L.RAD,AREA,LENGTH
2095  REM MXT=TOTAL TIME
3005  REM TM,Q..TEMP VAR FOR TIME
     CONV
3015  REM T1,T2.TIME USED,LEFT
3025  REM F1,F2.FEET USED,LEFT
9999  END
```


Circle 46 on inquiry card. →

There are two sides to our story.

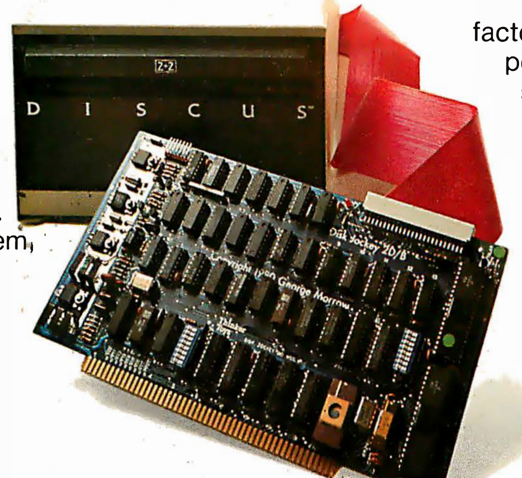
Side One

The DISCUS™ 2+2 Quad-Density Hardware

Now you can use your S-100 system to tackle big jobs. Because the DISCUS™ 2+2 Quad-Density Disk System puts 1.2 megabytes of fast-access memory on your side for just $1545.00 complete.

With the DISCUS™ 2+2 System, complete means complete.

You get a full-size (IBM-compatible 8") double-sided/double-density disk drive,



factory mounted in a cabinet with power supply, fully-buffered S-100 single-board controller, and interconnecting cables. All fully assembled, system-tested and fully warranteed.

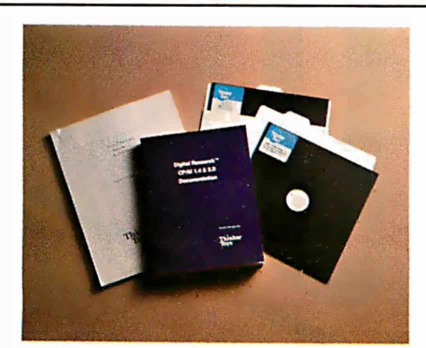
You get the speed and efficiency of 1.2 megabyte-per-diskette memory... and you get it for 0.13¢ per byte.

Side Two

The DISCUS™ 2+2 Quad-Density Software

1.2 megabyte quad-density hardware is only one side of the story. The DISCUS™ 2+2 System price includes all the fully-interfaced, high-performance software you need to take full advantage of your quad capacity.

The system includes our exclusive BASIC-V™ virtual disk BASIC, which allows you to address your quad-density diskettes as easily as main memory. The operating system you get is the widely accepted CP/M* 2.1. And you get our powerful DISK-ATE text editor/assembler; The most advanced software



development tool available.

Micro-Soft BASIC 5.1 and Micro-Soft FORTRAN are available as options. Both run under CP/M* 2.1.

Check out the full system price of DISCUS™ 2+2 Quad against any other floppy disk system at your local computer store. At $1545.00, we think you'll take sides with DISCUS™ 2+2.

If your dealer doesn't carry THINKER TOYS products, write MORROW DESIGNS Inc., 5221 Central, Richmond, CA 94804. Or call (415)524-2101 9-5 weekdays (Pacific Time).

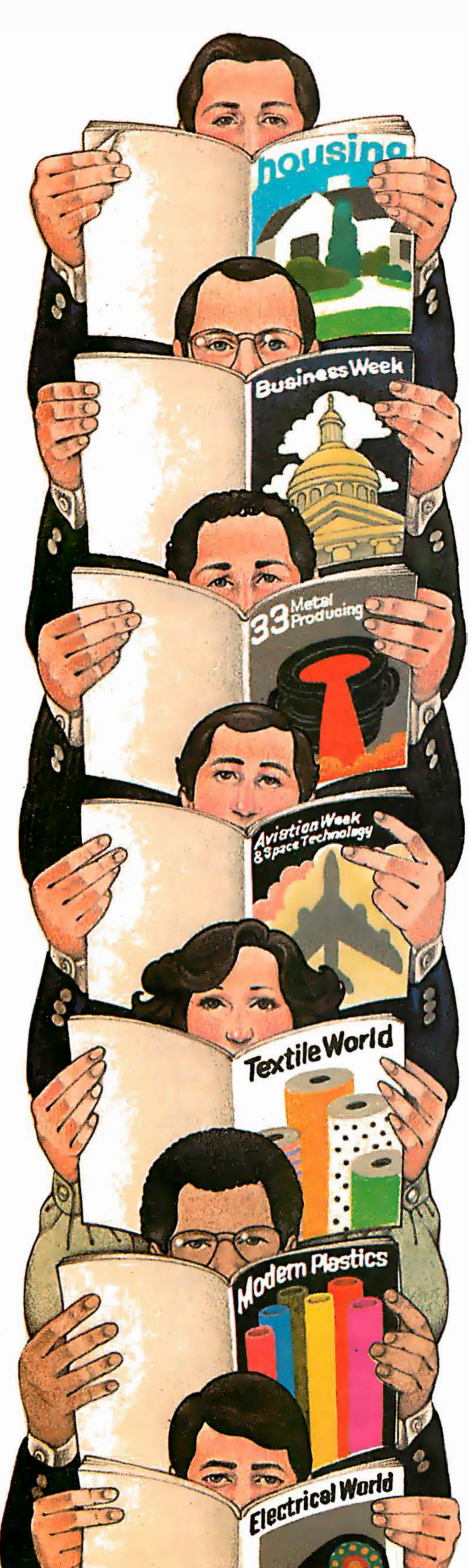
MORROW DESIGNS™/ Thinker Toys™

*CP/M is a trademark of Digital Research.

Today one dollar buys about ¾ of a gallon of gas.



Today one dollar buys 6¼ readers who actually see your sales message.



As your selling dollar buys less and less, it pays more and more to advertise in McGraw-Hill magazines.

As prices keep going up and up, McGraw-Hill magazines help 10.8 million decision-makers keep costs down.

For example, *Fleet Owner* readers learned how they could use re-manufactured air cleaners to save money without sacrificing quality. And *Chemical Week* constantly warns manufacturers about even more government regulations.

By helping 10.8 million readers solve their inflation problems, we help you solve yours.

Today, the price of reaching one potential customer in McGraw-Hill magazines is only 16¢.[1] This compares to a cost of $6.07 for sending a business letter,[2] over $3.50 for a business phone call,[3] and an in-person sales call which, believe it or not, now costs over $100.[4]

In times like these, when everything costs more, you may be tempted to spend less on your advertising budget. But our Laboratory of Advertising Performance (LAP) Report #5262, demonstrates that "Industrial companies which maintained or increased their advertising expenditure during the 1974-75 recession enjoyed higher sales growth than those which cut advertising." Write for LAP Report #5262 today at 1221 Ave. of the Americas, N.Y., N.Y. 10020. And let us help you make your advertising more efficient, as the price of all other selling tools becomes more expensive.

[1]One reader-noted impression in the average McGraw-Hill publication. [2]The Dartnell Institute of Business Research. [3]"Telephone Marketing" by Murray Roman, P. 87, McGraw-Hill 1976. [4]Laboratory of Advertising Performance Report #8013.4, McGraw-Hill Research.

McGraw-Hill Magazines.



With inflation, we're an even better buy.

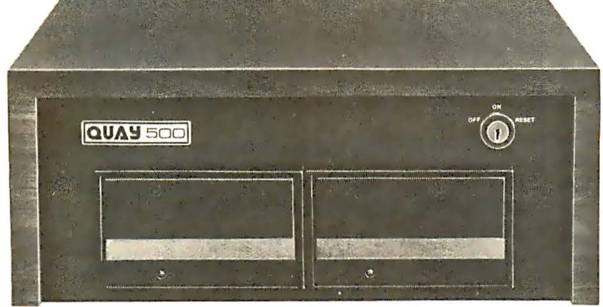
Table 1: *A tape counter/time table (produced by the program in listing 1) for a cassette recorder using C-60 tape. The last two columns were not printed by the program, but are a check value from an actual test of the program's accuracy.*

```
]

]RUN
HUB DIAMETER(INCH)? .8525
TAPE LENGTH LESS LEADER(FEET)? 303.6
TURNS COUNT AT END OF TAPE? 641
TURNS COUNT READING FOR
100 ACTUAL TAKE-UP TURNS? 77.3
1 . . . 15/16        IPS
2 . . . 1-7/8        IPS
3 . . . 3-3/4        IPS
4 . . . 7-1/2        IPS
5 . . . 15           IPS
6 . . . 30           IPS
WHICH TAPE SPEED? 2
CALCULATING TAPE THICKNESS AS WOUND . . .
```

TURNS COUNT	ELAPSED TIME	REMAINING TIME	FEET USED	FEET LEFT	TIME BY TEST	ERROR (SEC)
0	00:00:00	00:32:23	0	304	0:00	0
10	00:00:19	00:32:04	3	301	0:19	0
20	00:00:38	00:31:45	6	298	0:39	−1
30	00:00:57	00:31:26	9	295	0:58	−2
40	00:01:17	00:31:06	12	292	1:18	−1
50	00:01:37	00:30:46	15	289	1:38	−1
60	00:01:58	00:30:26	18	286	1:59	−1
70	00:02:18	00:30:05	22	282	2:20	−2
80	00:02:40	00:29:43	25	279	2:42	−2
90	00:03:01	00:29:22	28	276	3:04	−3
100	00:03:23	00:29:00	32	272	3:26	−3
110	00:03:46	00:28:37	35	269	3:48	−2
120	00:04:08	00:28:15	39	265	4:11	−3
130	00:04:31	00:27:52	42	262	4:34	−3
140	00:04:55	00:27:28	46	258	4:58	−3
150	00:05:19	00:27:04	50	254	5:22	−3
160	00:05:43	00:26:40	54	250	5:46	−3
170	00:06:07	00:26:16	57	247	6:11	−4
180	00:06:32	00:25:51	61	243	6:36	−4
190	00:06:58	00:25:25	65	239	7:01	−3
200	00:07:23	00:25:00	69	235	7:27	−4
210	00:07:49	00:24:34	73	231	7:53	−4
220	00:08:16	00:24:07	77	227	8:20	−4
230	00:08:43	00:23:40	82	222	8:47	−4
240	00:09:10	00:23:13	86	218	9:14	−4
250	00:09:37	00:22:46	90	214	9:41	−4
260	00:10:05	00:22:18	95	209	10:09	−4
270	00:10:34	00:21:50	99	205	10:37	−4
280	00:11:02	00:21:21	103	201	11:06	−4
290	00:11:31	00:20:52	108	196	11:35	−4
300	00:12:01	00:20:23	113	191	12:04	−3
310	00:12:30	00:19:53	117	187	12:34	−4
320	00:13:00	00:19:23	122	182	13:05	−5
330	00:13:31	00:18:52	127	177	13:34	−3
340	00:14:02	00:18:21	132	172	14:05	−3
350	00:14:33	00:17:50	136	168	14:37	−4
360	00:15:04	00:17:19	141	163	15:08	−4
370	00:15:36	00:16:47	146	158	15:40	−4
380	00:16:09	00:16:14	151	153	16:12	−3
390	00:16:41	00:15:42	156	148	16:45	−4
400	00:17:15	00:15:09	162	142	17:18	−3
410	00:17:48	00:14:35	167	137	17:51	−3
420	00:18:22	00:14:01	172	132	18:25	−3
430	00:18:56	00:13:27	177	127	18:59	−3
440	00:19:30	00:12:53	183	121	19:33	−3
450	00:20:05	00:12:18	188	116	20:08	−3
460	00:20:41	00:11:42	194	110	20:44	−3
470	00:21:16	00:11:07	199	105	21:19	−3
480	00:21:52	00:10:31	205	99	21:54	−2
490	00:22:29	00:09:54	211	93	22:31	−2
500	00:23:05	00:09:18	216	88	23:07	−2
510	00:23:43	00:08:40	222	82	23:44	−1
520	00:24:20	00:08:03	228	76	24:21	−1
530	00:24:58	00:07:25	234	70	24:59	−1
540	00:25:36	00:06:47	240	64	25:37	−1
550	00:26:15	00:06:08	246	58	26:16	−1
560	00:26:54	00:05:29	252	52	26:54	0
570	00:27:33	00:04:50	258	46	27:33	0
580	00:28:13	00:04:10	265	39	28:13	0
590	00:28:53	00:03:30	271	33	28:53	0
600	00:29:33	00:02:50	277	27	29:33	0
610	00:30:14	00:02:09	283	21	30:13	+1
620	00:30:55	00:01:28	290	14	30:54	+1
630	00:31:37	00:00:46	296	8	31:35	+2
640	00:32:19	00:00:04	303	1	32:17	+2
641	00:32:23	00:00:00	304	0	32:28	0 ■

a new star is born!



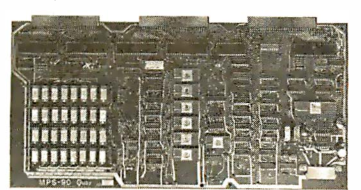
a better computer system any way you look at it.

The facts speak for themselves. The QUAY 500 SERIES offers more for the money than North Star Horizon computers.

MORE TECHNICAL FEATURES. A single board computer instead of a backplane with multiple boards, means fewer parts, fewer interconnections and fewer problems □ additional disk capacity for more program storage □ DMA controlled disk transfers for increased system performance □ on-board expansion capabilities for additional parallel and serial ports, and EPROM □ AC convenience outlets □ a more compact design.

IMMEDIATE DELIVERY. The 500 SERIES is available off the shelf for virtually immediate delivery. No waiting for far off delivery dates for this one.

LOWER PRICE. The advanced technology engineered into Quay computers actually lowers our cost to manufacture. The price of the 500 SERIES is about 20% lower than the Horizon-2-32K-D — and our 520 SERIES also offers significant savings over the Horizon-2-32K-Q.



Advanced single board modular design.

The bottom line is simple. There is a new star in the computer field. The 500 SERIES by Quay. It outshines all of the competition.

COMPARE FOR YOURSELF:

SPECIFICATION	QUAY 500	HORIZON-2-32K-D
Architecture	**Single Board**	S100 bus
CPU	Z80A, 4MHz.	Same
Dynamic RAM (std/max)	32/64 Kb.	Same
Disk drive type	Double density	Same
No. of drives (std/max)	2/4	Same
Capacity per drive (on-line)	**200 Kb.**	180 Kb.
Direct Memory Access (DMA)	**Yes**	No
CP/M® disk operating system	**Standard**	Optional
Unit Price	**$2,500.**	$3,095.

SPECIFICATIONS	QUAY 520	HORIZON-2-32K-Q
Disk drive type	Quad density	Same
Capacity per drive (on-line)	**400 Kb.**	360 Kb.
Unit Price	**$3,200.**	$3,595.

The QUAY 500 offers technical superiority—availability—a $2,500 price!



P.O. Box 386, Freehold, New Jersey 07728 ■ (201) 681-8700
Factory: Route 34, Wall Township, New Jersey 07719

DISTRIBUTOR AND REPRESENTATIVE INQUIRIES WELCOME

Circle 47 on inquiry card.

Dissecting the TI Speak & Spell

Michael A Rigsby
5164 Sunburst Dr
Norcross GA 30092

There is now an economical way to provide limited voice output for computer-controlled devices. TI (Texas Instruments) provides most of the hardware in its familiar toy called the "Speak & Spell."

Because I am fascinated by toys (my system is a hand-wired 1802 processor used in a self-contained, maze-solving mouse), it was only natural that I should procure my own birthday present—a toy—and immediately tear it apart.

Speak & Spell is an educational aid designed for children aged seven or older. It contains a vocabulary of greater than 230 words in addition to the letters of the alphabet. Asking questions and playing games with electronic speech, it expects answers to be entered on its 40-switch keyboard. Each entry evokes an audible response, and the machine even keeps score. Plug-in modules are available to expand the vocabulary. Suggested retail price for the toy is $65, though I bought mine for less than $40 at a major Atlanta department store.

Operation of the electronic portion of the Speak & Spell involves many unknowns. I am sure that the manufacturer would probably prefer to keep these unknowns secret, but I can provide some insight into the operation of the Speak & Spell.

The first great obstacle encountered when opening the machine is the back cover. Removing the two Phillips-head screws is a good step, but not good enough. There are still four slots, each containing a plastic hook over a plastic ledge. Take a thin-bladed screwdriver and push the hook toward the outside edge of the case, at the same time pull the front and back of the case apart with substantial force. Continue until all four hook slots are free. Take care not to allow any backsliding. I have done this three times, each time expecting to destroy it, but everything is still intact.

After reaching the inside, there is not much to see except the back of a double-sided printed-circuit board. To turn the board over, the matrix switch cards (figure 1) must be released from the front of the case. This involves springing delicate plastic hooks. If one of these hooks should break, the toy is lost. Somehow I slipped the cards out and turned the main board over. (See photo 1 and figure 2 on page 82.) On the opposite side of the main board are a circuit board (with a little black round thing on it) on top of the main circuit board, an 8-character alphanumeric display, and four integrated circuits, each with a distinctive proprietary number. The small circuit board appears to be a power supply.

The toy operates from a 6 V supply (four C cells), but +6 V, −6 V, and −20 V may be found throughout the board. The processor has five input lines from the switches; five lines seem to interconnect most of the circuits. The five input lines from the switches are activated upon contact closure by −20 V pulses generated within the processor.

At this point I will refer to figure 1. Eight bits from any processor may be used to control each of thirty-two lines by means of the 74154 binary-to-hexadecimal decoder. Each output line must go to a PNP transistor capable of switching a −20 V signal. The drawing in figure 1 indicates which wires go with which letters,

Text continued on page 84

MICROWORLD®

CALL
TOLL-FREE 1-800-528-1418

SPECIALS

ATARI 800 SYSTEM



MicroWorld now offers complete systems based around the Atari 800 Personal Computer . . . all peripherals available! The Atari 850 Interface Module, with four RS232 serial ports, an 8-bit parallel port, and an I/O port for connection to the Atari 800 allows for extensive upgrading of the basic system. Choose between two printers: the Atari 820 40-column printer, or the 825 80-column printer, both packed with standard features. Atari's new 810 floppy disk drives provide up to 92K of storage each . . . up to four of these drives may be accommodated within a system! The Atari 410 program recorder with both digital and audio tracks is used by the Atari Talk and Teach educational cassettes, and by the Invitation to Programming Series. A Bell 103/113 compatible modem is also available for use with the Atari 800 or 400, allowing communications with other types of computers, including time share services. The complete line of Atari products, plus Atari's vast library of applications software. . . all from MicroWorld!

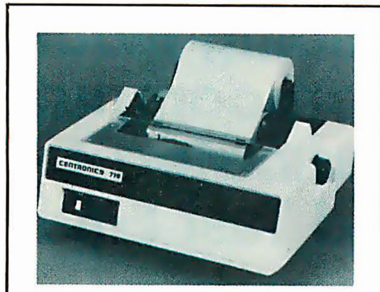
Call for Special Price!



OKIDATA MICROLINE 80

Compact, low-cost 80 cps printer; 9x7 matrix, friction or pin feed! 132 col. w/compressed print, graphics, and more! Tractor feed optional.

CALL FOR PRICE!



CENTRONICS 737

Low-cost 50-90 cps RO printer. Proportional spacing, generates full ASCII, prints sub- and superscripts, underline!

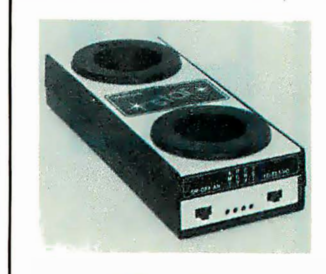
CALL FOR PRICE!



TI 99/4 HOME COMPUTER

Packed with features! Superior sound, 16-color graphics, powerful TI BASIC, optional speech! Up to 72K total memory capacity.

CALL FOR PRICE!



LIVERMORE STAR

Exclusive triple seal allows for superior acoustic isolation! 0 to 300 baud, locks into standard headset. Full duplex/test/half duplex modes.

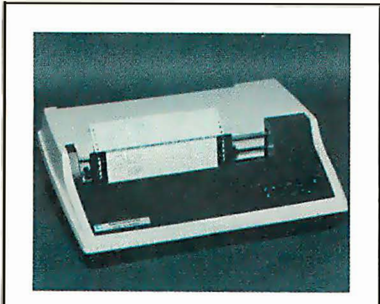
CALL FOR PRICE!



LEAR SIEGLER ADM-3A

The original "Dumb Terminal" . . . 12″ non-glare screen, 24x80 display. Feature direct cursor addressing, RS232 extension port, baud rates to 19,200!

CALL FOR PRICE!



TI 810 FULLY LOADED!

RO printer; low price includes full ASCII, vertical forms control, compressed print, 150 cps, RS232, tractors, 3″ to 15″ form width, bidirectional printing!

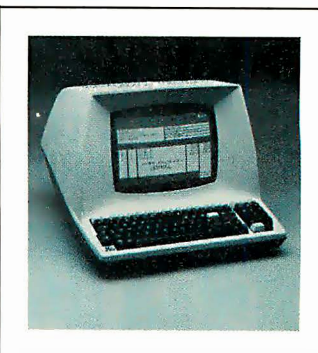
CALL FOR PRICE!



ZENITH-HEATH Z-89 ALL-IN-ONE COMPUTER

Built-in minifloppy drives, smart terminal with 25x80 display. Low price includes HDOS and 48K memory!

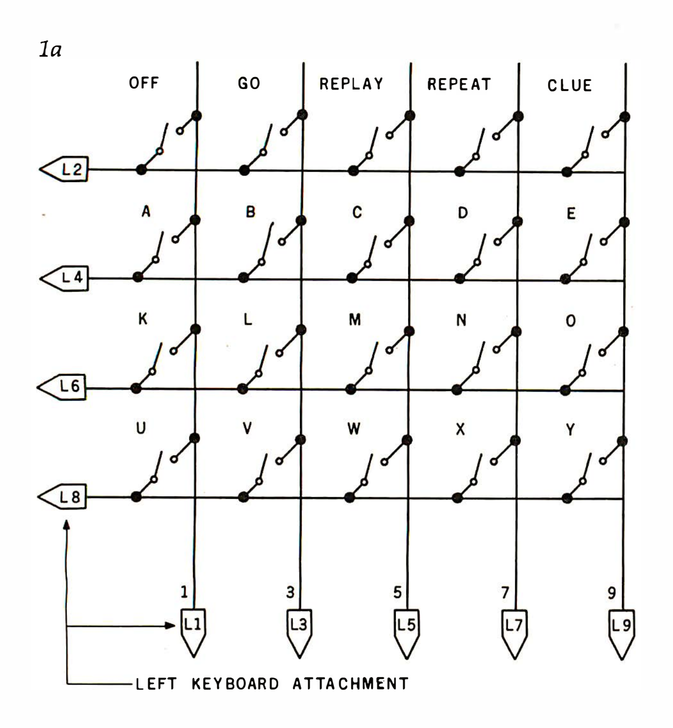
CALL FOR PRICE!



TELEVIDEO 920C

Low-cost terminal loaded with features; full-function keyboard, 24x80 display, blink, reverse, self-test!

CALL FOR PRICE!



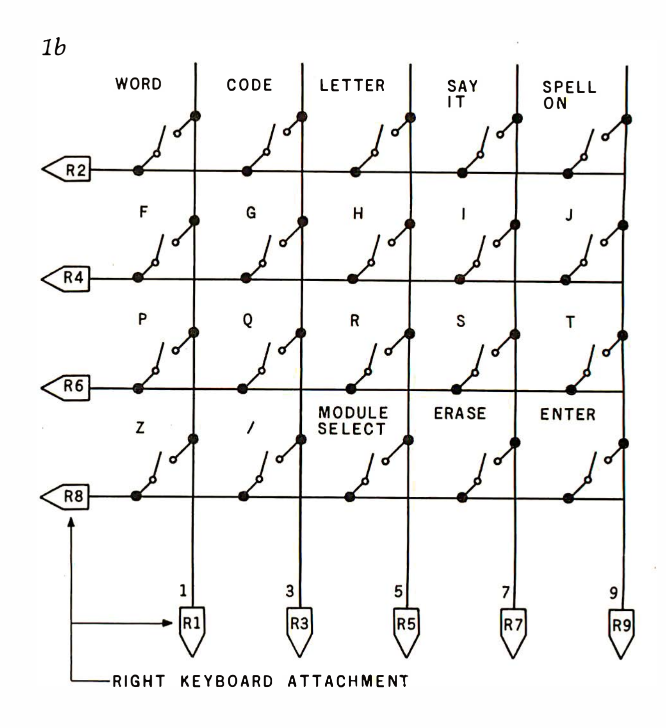


Figure 1a and 1b: *During normal operation, the Speak & Spell will voice a phoneme (letter sound) after a key is pressed on one of the keyboards. The Speak & Spell can be controlled by a microprocessor interfaced to the keyboard lines as shown in figure 1c.*

Introducing quality print at matrix speed. For only $1295.*



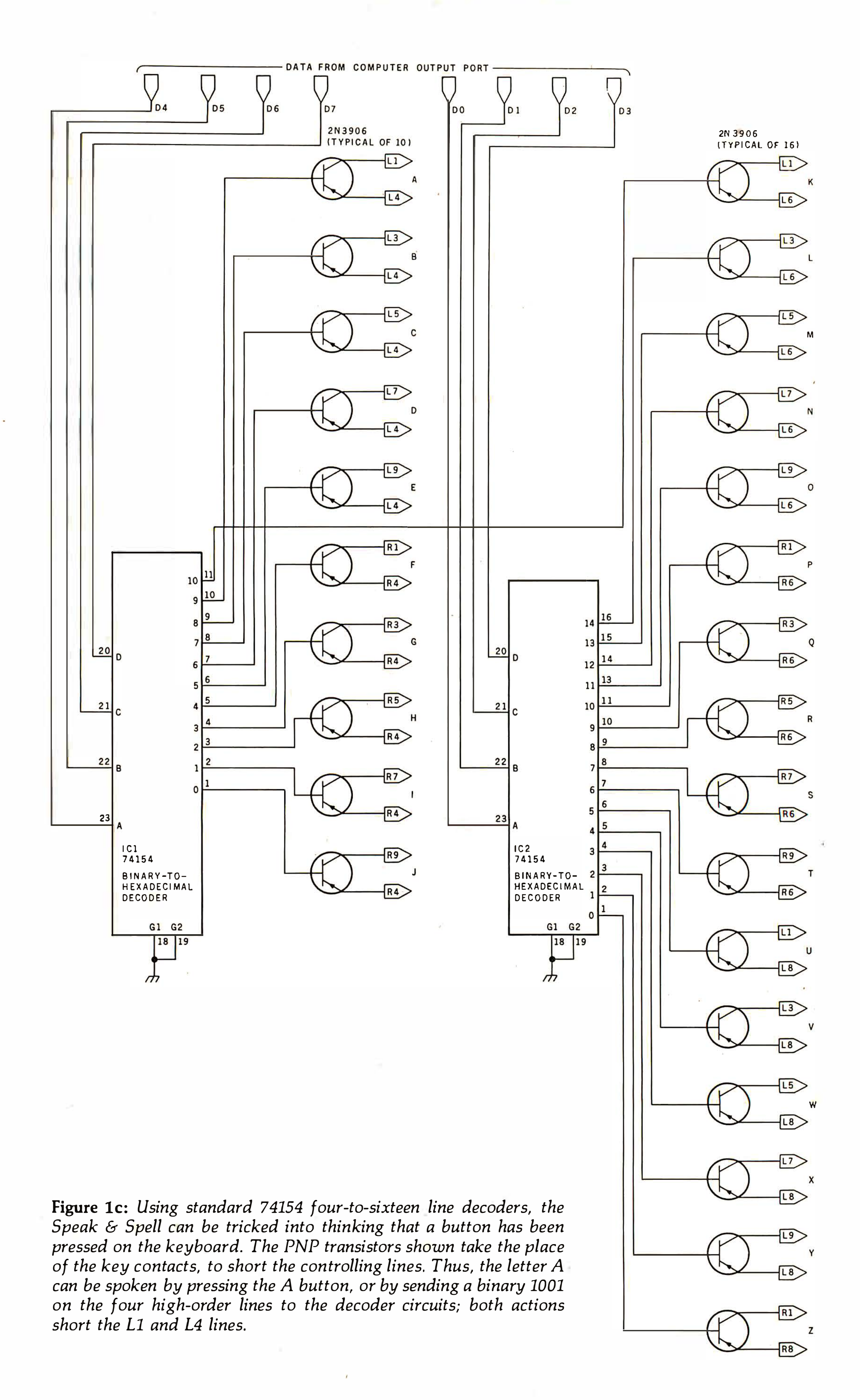


Figure 1c: *Using standard 74154 four-to-sixteen line decoders, the Speak & Spell can be tricked into thinking that a button has been pressed on the keyboard. The PNP transistors shown take the place of the key contacts, to short the controlling lines. Thus, the letter A can be spoken by pressing the A button, or by sending a binary 1001 on the four high-order lines to the decoder circuits; both actions short the L1 and L4 lines.*

Now! North Star Application Software!

North Star now offers application software for use on the HORIZON! Now you have one reliable source for both hardware and software needs! The first packages available are:

NorthWord—
NorthWord is a simple-to-operate word processing system designed for use with the popular North Star HORIZON. NorthWord enables you to increase office efficiency and cut document typing time and cost. NorthWord incorporates the most sought-after word processing features: easy editing, on-screen text formatting, simultaneous document printing, and much more. NorthWord can be integrated with other North Star software packages to produce customized letters, labels and reports quickly and efficiently.

MailManager—
MailManager enables you to compile and maintain complete organized mailing lists. Lists are easily accessible and can be compiled with a great deal of flexibility. Entries, corrections and deletions are easily made. The North Star MailManager can print your list on individual envelopes, on mailing labels, or in compact summary form.

InfoManager—
InfoManager is a powerful list-oriented, data management system. It will accept up to 50 categories of information for each record and has the ability to select and sort before printing. The North Star InfoManager has power and flexibility for many applications: product inquiry, inventory, customer/client records, calendar reminders, and as an easy way to fill in often-used forms.

GeneralLedger—
General Ledger and Financial Reporting, two programs in one, maintains general ledger accounts based on such input as checks, bank deposits and journal entries, and uses the information in the general ledger to produce customized financial statements and financial reports.

NorthWord is the central building block for all the North Star application software to follow. Packages now being tested include other accounting and professional application packages. For more information or a demonstration, contact your local North Star dealer.

NorthStar

North Star Computers, Inc.
1440 Fourth Street
Berkeley, CA 94710
(415) 527-6950
TWX/Telex 910-366-7001



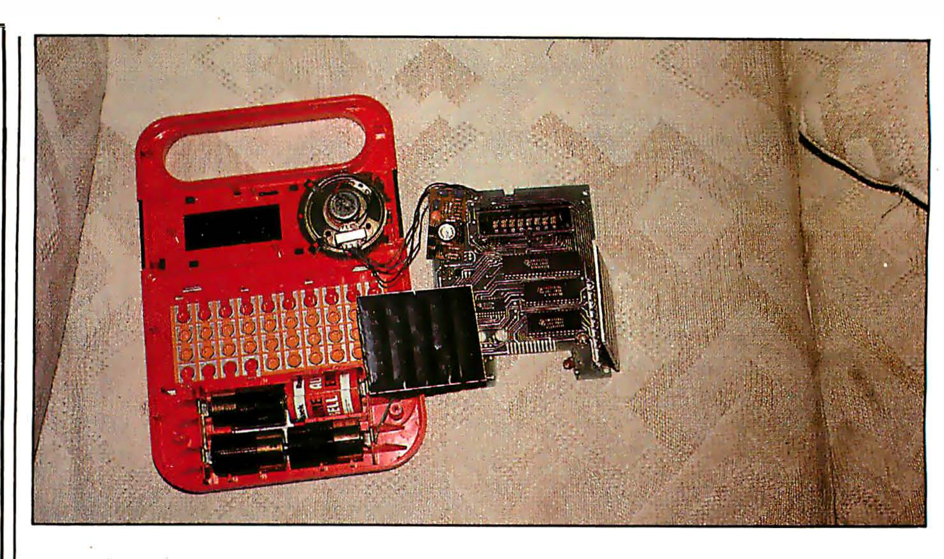


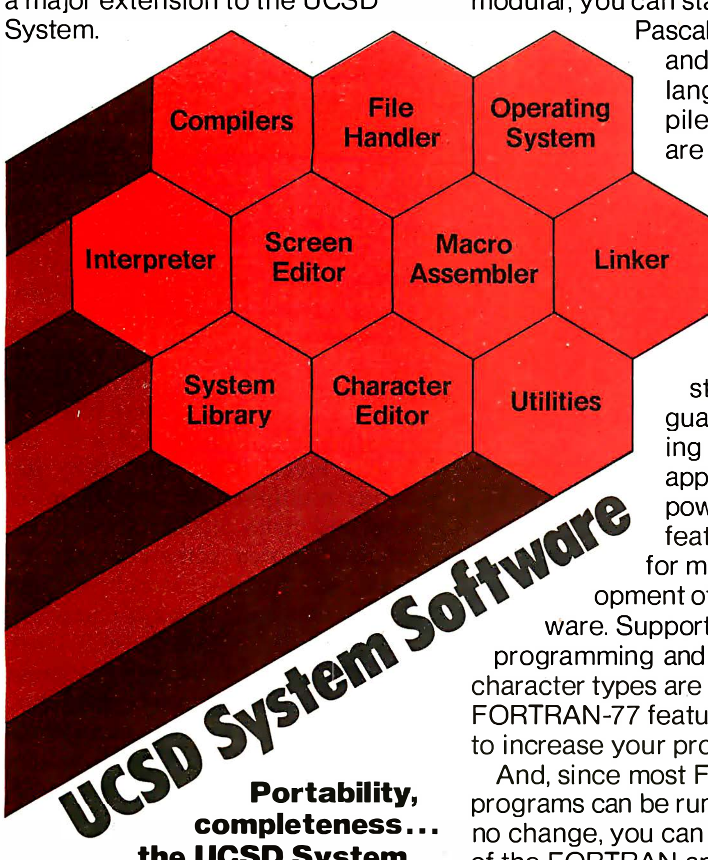
Photo 1: *Detailed photograph of the disassembled Speak & Spell. The main circuit board is shown in the same position as in figure 2; the board in the upper left-hand corner is the power supply. The black box at bottom center is one of the two keyboard assemblies.*

OUTPUT TO SPEAKER TRANSFORMER
POWER SUPPLY BOARD
8 CHARACTER DISPLAY
PROCESSOR TMC0271NL
CONNECTIONS TO LEFT HALF OF KEYBOARD
L1 L2 L3 L4 L5 L6 L7 L8 9 (−) (+)
KEYBOARD ATTACHMENT
SOUND GENERATOR TMC0281NL
UNKNOWN #1 (HIGH-DENSITY READ-ONLY MEMORY) TMC0351NL
UNKNOWN #2 (HIGH-DENSITY READ-ONLY MEMORY) TMC0352NL
CONNECTIONS TO RIGHT HALF OF KEYBOARD
R1 R2 R3 R4 R5 R6 R7 R8 9
KEYBOARD ATTACHMENT
SOCKET FOR PLUG-IN MODULE
SPEED POTENTIOMETER (CLOCK CONTROL)

Figure 2: *Layout of the Speak & Spell main circuit board, viewed from the front of the toy.*

The new microcomputer FORTRAN you'll be proud to take anywhere.

Microcomputer users like you want the best of all worlds. A single development and run-time system that can support FORTRAN on hundreds of thousands of systems ...a standard FORTRAN that is available immediately for whatever micro you have...plus the power, portability and completeness of the UCSD™ System. Impossible? It was until now. Until SofTech Microsystems introduced FORTRAN-77, a major extension to the UCSD System.



Portability, completeness... the UCSD System

FORTRAN-77 applications are as portable as UCSD Pascal™ applications. This is because the UCSD System runs on most all major micros...giving you the freedom to choose the hardware best suited to your needs...and the ability to market your applications to the broadest range of microcomputers possible.

Since UCSD Pascal and our new FORTRAN-77 are fully compatible, you can write applications that use the advantages of each language. For instance, you can utilize powerful Pascal subroutines for data display and graphics and FORTRAN subroutines for numerical calculations. And, because our system is modular, you can start now with Pascal or FORTRAN and add additional language compilers when you are ready.

Power... ANSI-77 FORTRAN

FORTRAN-77 is the newest ANSI standard language for engineering and scientific applications, with powerful new features included for more rapid development of reliable software. Support for structured programming and improved character types are just a few of the FORTRAN-77 features designed to increase your productivity.

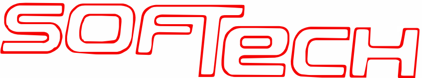
And, since most FORTRAN-66 programs can be run with little or no change, you can take advantage of the FORTRAN applications programs that already exist.

Solution...the complete UCSD System

For all the tools and support you'll ever need, order the UCSD System. Get a complete development and runtime package that includes an operating system, screen editor, file handler, macro assemblers, linker, P-code interpreter, the language compiler of your choice, and full documentation.

Whether you run UCSD Pascal or our new FORTRAN-77 on whatever microcomputer you have, you'll join the more than 10,000 satisfied UCSD System software users worldwide.

Call or write for more information; Master Charge or Visa orders accepted.



MICROSYSTEMS
A SUBSIDIARY OF SOFTECH
9494 Black Mountain Road, San Diego, CA 92126. (714) 578-6105.

You've got your choice with UCSD™ System Software. Use it on microcomputers with CP/M, or on any system using a Z-80, 8080/8085, LSI-11,™ 6502, 6800, 6809, or 9900 microprocessor.

- ☐ Send me the Complete set of UCSD System documentation including the FORTRAN and Pascal languages. My check or money order for $50 is enclosed. $50
- ☐ Send me more information about the UCSD System with FORTRAN
- ☐ Send me more information about the UCSD System with Pascal
- ☐ Send me more information about the UCSD System with both FORTRAN and Pascal
- ☐ Send me Distributor information

Name____________

Company____________

Address____________

City/State/Zip____________

Telephone____________

Massachusetts and California residents add applicable sales tax. CM-17E-(5/80)

Circle 54 on inquiry card.

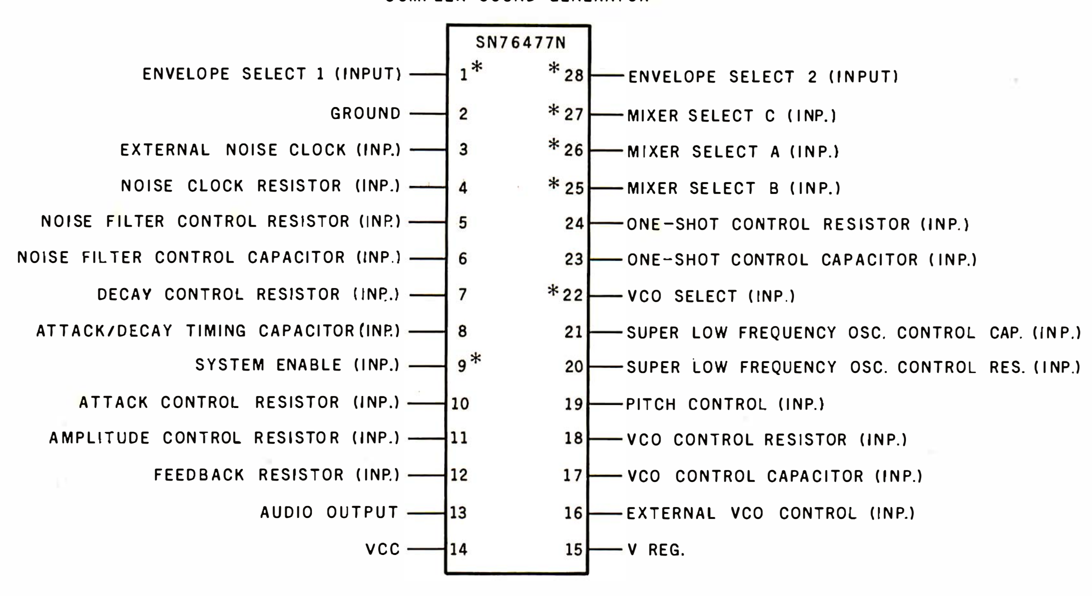


Figure 3: *Pin assignments for the SN76477N complex-sound generator. It is suspected that this well-known device is marked TMC0271NL in the Speak & Spell. The pins marked with asterisks are in a logical low state unless they are pulled up by an external voltage.*

Behavior	Pin # of TMC0271NL	Connected To Pin	Device #	Informal Name
steady pattern when letters are pronounced, variable pattern for all words	22	4	TMC0351NL	Unknown #
	25	11	TMC0271NL	Processor
	27	14	TMC0271NL	Processor
variable pattern for all speech	26	6	TMC0351NL	Unknown #1
	28	36	TMC0271NL	Processor

Table 1: *Experimental behavior of selected logic lines coming from the TMC0271NL device on Speak & Spell circuit board.*

Text continued from page 76:
while figure 2 shows the location of these wires in the toy. Each line must be released before the processor will accept another input command.

Returning to the operation of the device, the 40-pin circuit is undoubtedly a processor. There are two integrated circuits which I have labeled as high-density read-only memory (however, this is only a guess). They contain the information for the 230 spoken words; the processor (TMC0271NL) appears to contain the spoken letters and a few brief words. Of the forty pins on the processor, five are input lines from the switches, seven are pulsed output lines to the switches, fifteen or more are output lines to the display, and three are output lines to the sound generator. Three of the lines that go to the display are part of the five lines that connect the processor to unknown circuit #1 (mentioned above as possibly being a high-density read-only memory). If the unknown circuits *are* memory devices, the individual byte locations are not addressed by the processor (there is an insufficient number of interconnecting lines for that purpose), but are possibly left to be sequenced by a clock and stopped by processor control.

I am reasonably certain that the sound is generated by a complex sound generator, SN76477N. This circuit is controlled by numerous resistor-capacitor combinations and seven digital-control lines. (See figure 3 and table 1.) If this device is the chip marked TMC0271NL in the Speak & Spell, then it is two of the seven control lines (pins 1 and 9) that are tied to ground all of the time. Five of the lines have varying signals, though three of these maintain a constant pattern when letters are being pronounced. The narrowest spike in a pulse train that is connected to a control line is 0.1 ms long. With a 230-word vocabulary, there is a controlled speech time of well over 100 seconds. Five lines multiplied by 100 seconds multiplied by 10,000 pulses per second yields 5,000,000 bits of information stored somewhere in the Speak & Spell—providing one assumes that each word is composed of individually stored pulses. There are probably subroutines that cause the production of phonetic elements. I can see no way to access these phonetic elements, because they seem to be internal and not directly addressable by normal address lines. Someone with more memory than I have (1 K bytes of user memory) could monitor the control lines on the sound generator (see figure 3) and perhaps determine the phonetic makeup of individual sounds.

If you don't mind listening to your computer spell everything, give it a voice and let it speak.■

the ABC's of CP/M®

NEW! CP/M HANDBOOK MAKES CP/M EASY AS ABC

CP/M–the industry standard in operating systems: now Sybex makes it easy as ABC with a new step-by-step guide: THE CP/M® HANDBOOK (with MP/M™).

Gain a clear understanding of CP/M's basic operation, learn how to use the editor and assembler, then explore all versions of CP/M, including CDOS and multi-user MP/M.

Numerous sample programs, practical operating hints and handy reference tables make the CP/M HANDBOOK a must for anyone–from beginner to experienced programmer.

For sophisticated editing or simple copying, the new CP/M HANDBOOK gives you a hand–and makes CP/M easy as ABC.

By Rodnay Zaks, 250 pp., Ref. C300, $13.95

Circle 55 on inquiry card.



**Dept. B9
2344 Sixth St.
Berkeley, CA.
94710**

AVAILABLE AT BOOKSTORES AND COMPUTER SHOPS EVERYWHERE

TO ORDER:

By Phone: (415) 848-8233, Visa, MC, Am Ex
By Mail: Indicate quantity. Prepayment required
Shipping: $1.50 per book (UPS) or 75¢ (4th Class)
Tax: In California please add tax

MAIL TO: SYBEX 2344 Sixth St., Berkeley, CA 94710

Send me ____ copy(s) of The CP/M Handbook @ $13.95

Name ____

Company ____

Address ____

City ____ State ____ Zip ____

Amount enclosed ____ ☐ UPS ☐ 4th class

Charge my ☐ Visa ☐ Master Charge ☐ Am. Ex.

Card number ____

Expiration date ____

Signature ____

☐ Send me your free catalog C300B9

Penny Pincher's Joystick Interface

Steven Wexler
1634 Buck Hill Dr
Huntingdon Valley PA 19006

One of the more entertaining input devices that can be operated by a human hand is the joystick. Physically, the device consists of a lever that moves in two dimensions. The lever operates two potentiometers, which translate the position of the lever into two analog resistance values. A joystick hardware interface, in conjunction with the appropriate software, can convert the resistance values into corresponding binary integer values. These integers can be used to move a cursor, alter music, or control a robot, along with a myriad of other applications.

There are several ways to interface a joystick to your computer. Each scheme has its advantages and disadvantages. The particular method I have chosen has the advantages of being inexpensive, easy to build, easy to understand, and of requiring a minimum of input/output (I/O) programming.

The disadvantages? This method is slower than some other interfaces I have seen, uses more software than do the expensive hardware-intensive schemes, and is less precise than some of the more elaborate circuit concoctions.

Operating Theory

The key to my "penny pincher's" joystick interface is the 556 dual timer configured as two monostable multivibrators or one-shots, as shown in figure 1. In English, this means that if you trigger the one-shot, its output will go high for a predetermined interval, after which the output will return to its normal low state.

By using a joystick potentiometer as a timing resistor, the duration of one output pulse will be proportional to the position, in one dimension, of the joystick lever. Software is used to convert the pulse duration into a binary value. Duplicating the circuit for the second timer, the other joystick potentiometer will yield a different output-pulse duration and binary value for the other dimension. Remember, joysticks operate in two or more dimensions.

Joystick Interface Circuit

Careful study of figure 1 will reveal a most curious aspect of the interface. The *trigger* and *reset* lines for each circuit are all tied to a common processor output line. This certainly saves output lines, but how can you trigger and reset simultaneously? An explanation of the trigger requirements for the timer circuits should help to clear up this anomaly.

Normally, the timer will start to output a pulse on the high-to-low transition (ie: negative-going edge) of the input trigger signal. For the device to work properly, it is necessary to return the trigger input to its normal high state before the timed-output pulse returns low. In other words, before the device times out, the trigger input must go high.

If the timer receives a trigger signal in the middle of an output pulse, the signal is ignored. The obvious conclusion is that we must either trigger each of the 556 timers independently, or we must reset the second timer before it is triggered. Otherwise, how are we to avoid attempting to trigger the second timer before it has timed out from the initial signal? Tying the resets and triggers to a common computer-output line avoids the timing pitfall, while simplifying both hardware and software.

When the computer-output line goes low, the timing function is reset and the device returns to its initial state. As the processor-output line returns high (ie: positive-going edge), the circuit is reset before it is triggered; this allows the timing pulse to begin normally. The I/O line used to reset and trigger the 556 can also be used to reset and trigger additional joysticks. How's that for efficiency! I have not included the values of the timing capacitors and potentiometers

Chief Relief

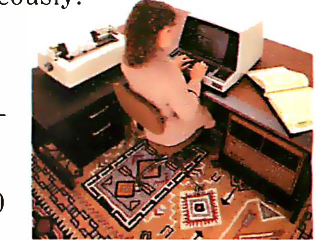
For years many small business system buyers thought that in order to get "real" performance and enough storage to be a "real" business system they would have to sacrifice the family jewels.

But with the introduction of the Smoke Signal Chieftain series office computers a lot of people's minds have been changed.

Because we designed the highly reliable Chieftain small business system with the most innovative combination of performance and efficiency around.

At your fingertips there are 64,000 characters of random access memory and you can address anywhere from 740,000 characters to 2 million characters with Smoke Signals's new double density controller. For larger concerns, there's a 20M byte hard disk available.

At a time when other small computer manufacturers tell you "you're on your own", Smoke Signal offers an abundance of easy-to-use software programs such as order entry, inventory control, accounts receivable, invoice entry, payroll, word processing and much, much more. There's BASIC, COBOL and FORTRAN — even a multi-user BOS (Business Operating System) that allows for numerous users simultaneously.



Chieftain systems starting at under $200.00 per month display performance on par with systems costing twice to three times as much.

So call (213) 889-9340 for your nearest authorized Smoke Signal dealer — he'll be glad to demonstrate the Chieftain's high reliability and ease of operation.

For dealers only, circle 57
All other inquiries, circle 56

SMOKE SIGNAL  **BROADCASTING**

31336 Via Colinas, Westlake Village, California 91361, (213) 889-9340

Number	Type	+5 V	GND
IC1	556	14	7

Figure 1: *The key to the penny pincher's joystick interface is the 556 dual timer, configured as two monostable multivibrators. The interval of each output pulse is determined by the joystick resistance, in conjunction with a user-selected timing capacitor.*

in figure 1; these values depend on software, processor speed, and personal preference.

Software

The software needed for the penny pincher's interface is very straightforward. The 556 timers are triggered by setting the proper computer-output line first low, then high. After this, the processor should enter a tight, time-efficient counting loop until one circuit times out. The software should immediately store the count and then start the process over for the next timer. It is recommended that you disable interrupts during the counting process; otherwise an inaccurate count may occur.

Listing 1 presents the joystick-driving software for my KIM-1 computer (6502 processor). The program assumes that the reset/trigger line is tied to the KIM-1 I/O line B1. The timer's outputs are tied to B2 and B3; a second joystick may be tied to lines B4 and B5.

Utilizing consecutive I/O lines in this manner allows for efficient I/O line polling by merely shifting an I/O mask. Figure 2 is a flowchart of the

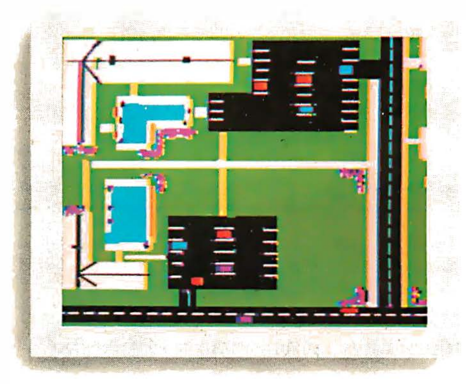


INTRODUCING VIDEOPRINT:
The picture perfect peripheral.

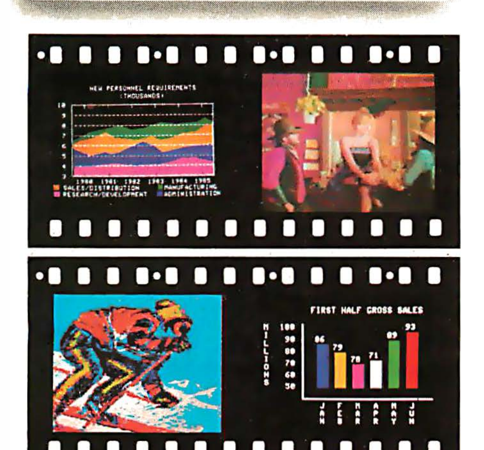
Videoprint is the convenient economical means of obtaining distortion-free line or continuous tone hardcopy from raster line computer graphics displays in full, brilliant color. The entire system is self contained in the convenient desk-top unit shown above.

Videoprints eliminate such off-the-screen photography problems as barrel distortion, color de-saturation and loss of color fidelity. Videoprints also minimize the effects of raster lines and video noise.

Videoprints are instantly produced with Polaroid® SX-70 or Polacolor 4″ x 5″ films, as well as with conventional color negative or 35 mm slide transparency films, offering you a range of handy sizes. The pictures can be made by untrained personnel at the push of a button.







If you've ever wanted to distribute copies of computer graphics or TV video stills or file them in your permanent records, or send them through the mail or project them as slides, you need Videoprint.

If you've ever wanted to document alternatives in an interactive graphics process, or monitor periodic events without 24-hour observation, you need Videoprint.

In fact, if you use computer graphics in any form, you really need Videoprint. Find out all about this exciting new tool. Write or call us today.



The Videoprint People.

Image Resource Corporation
2260 Townsgate Road, Westlake Village, CA 91361
(805) 496-3317

Circle 59 on inquiry card.

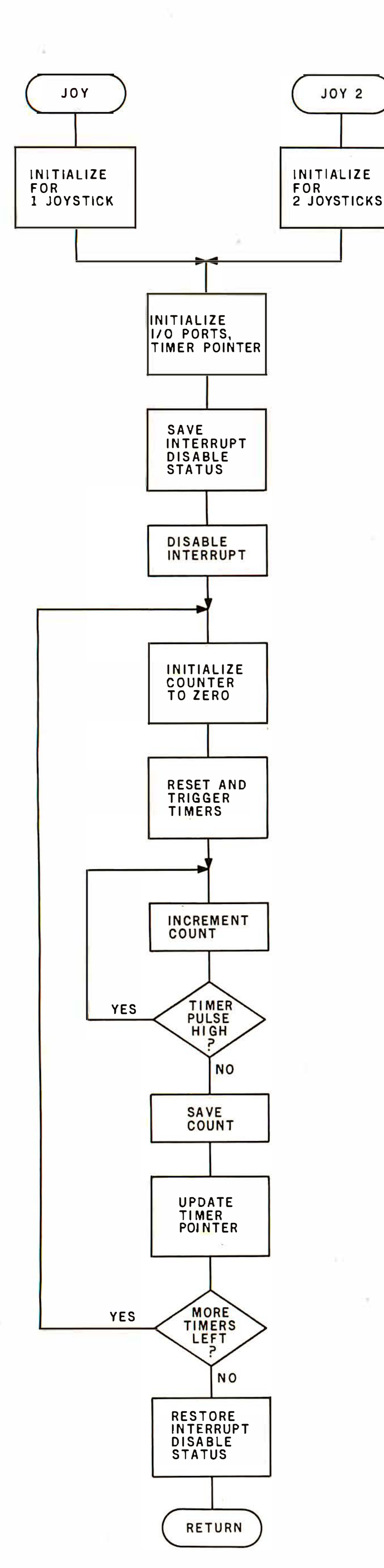


Figure 2: *The joystick-driving software consists mainly of a counting loop; this determines the stick position by timing the output pulse interval. High resolution can be attained by using a fast counting loop.*

Listing 1: *The software used on the author's KIM-1 system resets the interface timers with a low logic state on I/O line B1. When the same line goes high, the timers are retriggered. This technique, using only one output line, contributes to the simplicity of the hardware.*

```
                    POT    =$17E3      POT 1, Y AXIS
                    POT+1  =$17E4      POT 1, X AXIS
                    POT+2  =$17E5      POT 2, Y AXIS
                    POT+3  =$17E6      POT 2, X AXIS
                    PBD2   =$1702      PORT B DATA REGISTER
                    PBDD2  =$1703      PORT B DIRECTION REGISTER

8510  A2 01         JOY    LDX #1      ENTRY FOR ONE JOYSTICK.
8512  D0 01                BNE HOP     FORCED JUMP.
8514  A2 03         JOY2   LDX #3      ENTRY FOR TWO JOYSTICKS.
8516  A9 02         HOP    LDA #2      INITIALIZE TIMER POINTER.
8518  8D 03 17             STA PBDD2   SET LINE B1 FOR OUTPUT, REST INPUT.
851B  08                   PHP         SAVE INTERRUPT STATUS.
851C  78                   SEI         DISABLE INTERRUPT.
851D  0A            LP     ASL         UPDATE TIMER POINTER.
851E  A0 00                LDY #0      TRIGGER TIMER VIA
8520  8C 02 17             STY PBD2    LOW TO
8523  A0 02                LDY #2      HIGH TRANSITION
8525  8C 02 17             STY PBD2    OF LINE B1.
8528  A0 FF                LDY #FF     INITIALIZE COUNTER.
852A  CA            LP1    INY         UPDATE COUNT.
852B  2C 02 17             BIT PBD2    TEST TIMING PULSE.
852E  D0 FA                BNE LP1     IF HIGH, CONTINUE COUNT.
8530  48                   PHA
8531  98                   TYA
8532  9D E3 17             STA POT,X   SAVE COUNT.
8535  68                   PLA
8536  CA                   DEX
8537  10 E4                BPL LP      MORE TIMERS?
8539  28                   PLP         NO, RESTORE INTERRUPT STATUS.
853A  60                   RTS
```

program. Remember to keep the counting loop as efficient as possible.

Calibration

The count we obtain from the interface is equivalent to the duration of the timing pulse divided by the processing time required by the computer to execute one counting loop. My 6502 system, running at a clock frequency of 1 MHz, will execute the counting loop in listing 1 (hexadecimal 852A thru 852E) in 9 μs. It stands to reason that if you want a joystick to read from 0 to 100 on this machine, you would choose a potentiometer and capacitor that would set the maximum duration of the timing pulse to 909 μs (101 × 9 μs).

The following formula is used to derive the value of the timing capacitor:

$$C = \frac{\text{pulse duration}}{1.1 \times R}$$

where C is in farads, duration is in seconds, and R is in ohms. Assuming a joystick with 100 k-ohm potentiometers, a 0.0083 μF capacitor is needed to produce a 909 μs timing pulse. Since the actual value of most capacitors is not precisely known, it may be desirable to trim the maximum timer intervals. This can be done by placing extremely small-value capacitors in parallel with the main timing capacitor of the circuit that has the *smaller* maximum pulse of the two. Silver mica capacitors should work well here.

Construction

The circuit is quite simple and compact. With point-to-point wiring, several joystick interfaces can be constructed on a small circuit card. Placement of components is not critical. Each interface should draw less than 40 mA from a +5 V supply. Surplus joysticks can be purchased for about $4, while the 556 timer costs less than $1; so, for about $6 and one night's work, you can add this joystick interface to your system.■

Apple vs IBM

IBM/370 users have VSAM (Virtual Storage Access Method) to provide fast, flexible keyed-access to their data. Now KRAM (Keyed Random Access Method), from United Software of America, gives APPLE users the same flexibility, substantially increasing the processing power of the APPLE.

Until KRAM, the only "random access" capability in the APPLE consisted of a crude form of "relative record" processing. While this is usable for very simple applications, it falls far short of the needs of today's business & analytical applications. Using KRAM, records may be processed by a "key" value, which may consist of any kind of data: numbers, letters, special characters, etc. Even APPLE's long-awaited DOS 3.3 doesn't have anything like this!!

Just compare: Consider an employee file in a Payroll application:

FUNCTION	APPLE'S DOS 3.3 RANDOM ACCESS	KRAM	FEATURES
Retrieve by Social Sec. #	NO	YES	Relative record is limited to 7 digit #'s; KRAM keys up to 48 bytes!
Retrieve by Last Name	NO	YES	Relative record cannot file alphabetically
Erase a record	NO	YES	Relative record cannot erase records
Dynamic record allocation	NO	YES	KRAM files grow as needed
Dynamic compression	NO	YES	KRAM recaptures space when records are deleted
Mutliple files open	NO	YES	KRAM can keep 5 files open simultaneously
BEST WAY	NO	YES	It's obvious

As you can see, KRAM now attains levels of sophistication on the APPLE that rival those of IBM mainframes. . . So why let the IBM users have all the power? Power up your APPLE with KRAM!

KRAM RELEASE 2.0 FUNCTIONS:

- *Create/Open a dataset*
- *Put record by key*
- *Add & Delete records by key*
- *Get any record by Full or*
- *Partial key in .4 sec.*
- *(.2 sec. with Corvus Disk)*
- *Supports multiple disks*
- *Read next or previous record*
- *Dynamic space allocation*
- *Dynamic space reclamation*
- *Dynamic index compression*
- *Never needs reorganization*

An 80 page manual fully documents KRAM 2.0 functions and illustrates with programming samples. KRAM architecture is fully explained and a sample mailing list application program is included.

APPLE & PET Requirements:

KRAM is designed to work with both APPLE's Disk II and Corvus Systems 10 Megabyte Winchester Disk, and Commodore's 2040, 3040, and 8050 Disk units. KRAM 2.0 requires 32K/48K APPLE with Integer Basic in ROM (compatible with APPLESOFT) and at least one disk drive. KRAM works on any 40/80 column 16K/32K PET.

Introductory Special $99.95



750 3RD Avenue, New York NY 10017
(212) 682-0347 ***Telex 640055***

Look for the RED-WHITE-BLUE United Software Display at your local computer dealer, or send check or moneyorder, plus $3.00 shipping to:

DEALER INQUIRIES INVITED

Biologically based paradigms provide insights into artificial intelligence.

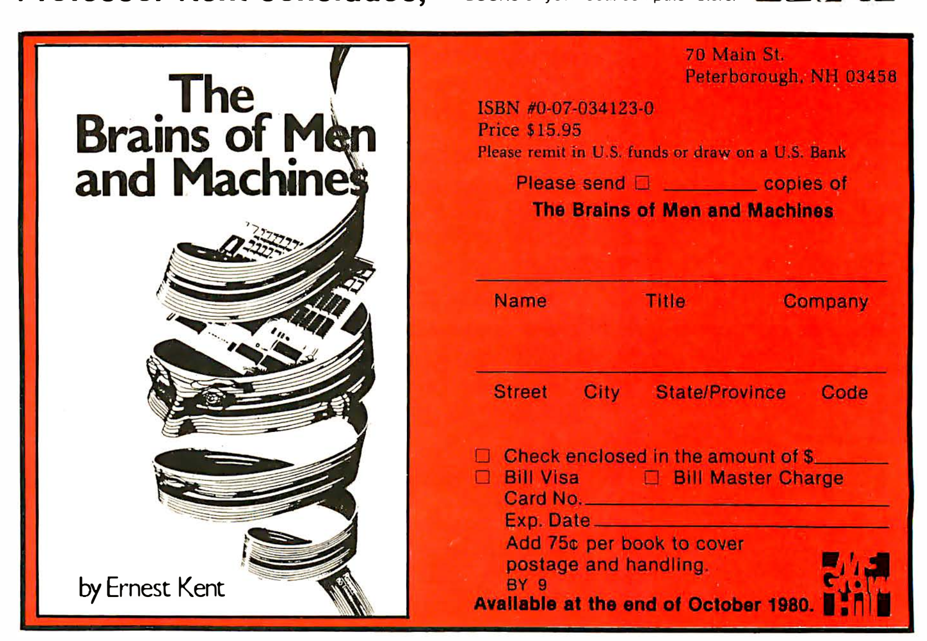
KNOW THYSELF

As researchers begin to unravel the mysteries of the brain's chemical, electrical and synaptic circuitry their findings are becoming immediately applicable to advances in robotic behavior and computer design. Ernest W Kent, a computerist and professor of both physiological psychology and psychopharmacology, dissects the brain to create biologically based paradigms providing new insights into computer design and artificial intelligence.

Professor Kent has written one of those rare and important works that transcends previously perceived disciplinary boundaries. The ever-increasing relationship between man and machines is freshly examined; a relationship, Professor Kent concludes, that more and more is being modeled after man's own neurological self image.

This and other BYTE/McGraw-Hill books are available from BYTE BOOKS or your local computer store.

BYTE BOOKS



70 Main St.
Peterborough, NH 03458

ISBN #0-07-034123-0
Price $15.95
Please remit in U.S. funds or draw on a U.S. Bank

Please send ☐ ________ copies of
The Brains of Men and Machines

Name Title Company

Street City State/Province Code

☐ Check enclosed in the amount of $________
☐ Bill Visa ☐ Bill Master Charge
Card No. ________
Exp. Date ________
Add 75¢ per book to cover postage and handling.
BY 9
Available at the end of October 1980.

Pascal and the Great Race

David A Mundie, 104 Oakhurst Cir, Charlottesville VA 22903

I have some comments on the record maintenance techniques described in "The Great Race and Micro Disk Files," by J J Roehrig (April 1980 BYTE, page 142).

Mr Roehrig's initial method took almost a minute just to write 120 real variables, so it is little wonder that he began looking for a better way. His decision to minimize disk transfers by not sorting the records on the disk seems eminently sensible. However, his other decision, to read and write individual elements of the array instead of using a FOR...NEXT loop is lamentable. Surely there is something wrong with a language so inefficient that loops are prohibitively slow. One wonders what he would have done had there been 1000 elements in the array rather than twelve.

Mr Roehrig might consider changing programming languages as a solution to his problem. The root of his difficulty is that BASIC does not allow for files of arrays (or any other structured data type, for that matter). In Pascal, it would be possible to define SCRATCH as a file of arrays of reals, with twelve reals in each array. Writing an array is then accomplished by the simple statement PUT(SCRATCH), while reading is done by GET(SCRATCH)—no loops, and especially no referencing of each element of the array.

Listing 1

```
PROGRAM RACETEST;
CONST DUMMYVALUE = 1.23456;
TYPE REALARRAY = ARRAY[1..12] OF REAL;
VAR I,J: INTEGER;
  DUMMY: REALARRAY;
  SCRATCH: FILE OF REALARRAY;
PROCEDURE CLOCK;
BEGIN
  WRITELN ('CLOCK: ');
  READLN
END;
BEGIN (*RACETEST—MAIN PROGRAM*)
  FOR I := 1 TO 12 DO
    DUMMY[I] := DUMMYVALUE;
  CLOCK;
  REWRITE (SCRATCH, 'SCRATCH');
  FOR I := 1 TO 10 DO
    BEGIN
      SCRATCH↑ := DUMMY;
      PUT (SCRATCH)
    END;
  CLOCK;
  FOR J : = 1 TO 5 DO
    BEGIN
      RESET (SCRATCH);
      FOR I := 1 TO 10 DO
        BEGIN
          DUMMY := SCRATCH↑;
          GET (SCRATCH)
        END;
    END;
  CLOCK;
  CLOSE (SCRATCH)
END.
```

A Pascal program equivalent to his program is given in listing 1. Because ten arrays of twelve reals do not fill up the minimum UCSD Pascal buffer of 512 bytes, for benchmarking purposes I actually used an array size of 120 real variables, then divided the execution times by 10. This yields a time of about 0.4 seconds to write ten records, compared to Mr Roehrig's minimum of 3 seconds, or the estimated 20 seconds using loops. Reading ten records five times took about 1 second, compared to his minimum of 6 seconds. Part of the difference may be attributable to hardware (I used a Pascal Microengine with double-density 8-inch disks), but I am convinced that the difference is largely due to Pascal's more rational handling of files. In this case, at least, higher-level constructs seem to be not only easier to use, but also more efficient than those at a low level. ■

Circle 62 on inquiry card. →



...Bulk Storage from Industrial Micro Systems

THE NEW MODEL 16

The new Industrial Micro Systems Model 16 Hard Disk Subsystem is a "fixed-removable" high speed, bulk storage device providing from 32 megabytes (32 million characters) to 96 megabytes of on-line storage for the Industrial Micro Systems 8000 or Series 5000 microcomputer systems. The Model 16 includes a credenza enclosure that provides a quiet, strong and attractive package for office or industrial applications where large memory is required. The Model 16 also includes a fully buffered DMA S-100 bus controller for fast and easy interfacing.

WINCHESTER TECHNOLOGY WITH BUILT-IN BACKUP

The Model 16 includes a 16 megabyte removable cartridge and a 16, 48, or 80 megabyte fixed media that employs Winchester 3340 technology. Files and programs may be copied between the fixed media and the removable cartridge for fast, easy backup and archival storage.



FAST ACCESS

The interface between the Model 16 hard disk and the Industrial Micro Systems computer is provided by the Hard Disk Controller. The Hard Disk Controller utilizes Direct Memory Access (DMA) for fast data transfer with minimum processor intervention. The maximum data transfer rate is 1.2 megabytes per second and the controller fully buffers the data, a sector at a time, to and from the disk. **Available in 220 V, 50 HZ Versions**

Now you don't have to look hard for fast computing power. Contact your Industrial Micro Systems Dealer today.

INDUSTRIAL MICRO SYSTEMS

Marketing	Manufacturing
628 N. Eckhoff, Orange, CA 92668	2800 Lockheed Way, Carson City, NV 89701
(714) 978-6966	(702) 883-7611

The article "A Power-Line Protection Circuit" by Neil Schneider and Bror Erickson (March 1980 BYTE, page 126) generated a great deal of correspondence. This included the following criticism by Mr Newswanger and the circuit offered by Mr Schafer.

Protection Circuits

Donald W Newswanger, Dept of Building and Safety, City Hall, Rm 485, Los Angeles CA 90012

I was disappointed to see the article "A Power-Line Protection Circuit" (March 1980 BYTE, page 126). No direct internal connection should ever be made to a *hot-chassis* transformerless television set. The antenna terminals may be safely used with a suitable RF (radio-frequency) modulator, but no attempt should be made to connect directly into the video circuit. Transformer-isolated television sets and monitors are readily available for this purpose.

The circuits in both figure 1 and figure 2 of that article introduce problems into the building wiring system. The use of either circuit will trip a ground-fault circuit breaker. Circuit 2 is particularly bad since it directly interconnects the ground wire and the neutral during normal operation. The neutral conductor of a two-wire circuit carries the same current as the *hot* wire of the circuit. The interconnection of the neutral and ground wire will cause part of the normal neutral current from all applicances connected to the circuit to flow through the ground wire. The ground wire is intended to provide a ground path for appliances and should never be used as a current-carrying conductor. These circuits violate the provisions of the National Electrical Code and the UL/ANSI Standards.

I have a low-cost personal computer and feel that my 120 VAC/12 VDC portable television set was a good investment. BYTE should encourage the use of line-isolated television sets and monitors and discourage the use of makeshift substitutes. ■

Steven A Schafer, 202 West Dr, Princeton NJ 08540

The purpose of the ground wire in the standard power delivery system is to provide a stable reference and to bleed away any small charges caused by leakage currents or static. It should *never* be used to supply power to any device. A current of more than a few milliamperes in the ground line is enough to trigger a ground-fault interrupter, if such a device is installed.

For the same reason, the neutral wire should never be connected to the ground wire; even though they are supposedly at the same potential, the neutral wire is not guaranteed to be at earth-ground, and connecting it to the ground wire will often cause a small current to flow. For obvious safety reasons, neither the hot nor the neutral side of the power line should be connected to any exposed conductor.

The circuit shown in figure 1 is a nearly foolproof way to protect against wiring errors. If a polarity error exists between the protected equipment and any other devices connected to it, relay 2 and the neon indicator will turn on, disabling relay 1 and preventing power from being applied to the protected equipment. If there is no error, relay 2 remains off, and depressing the push-button switch

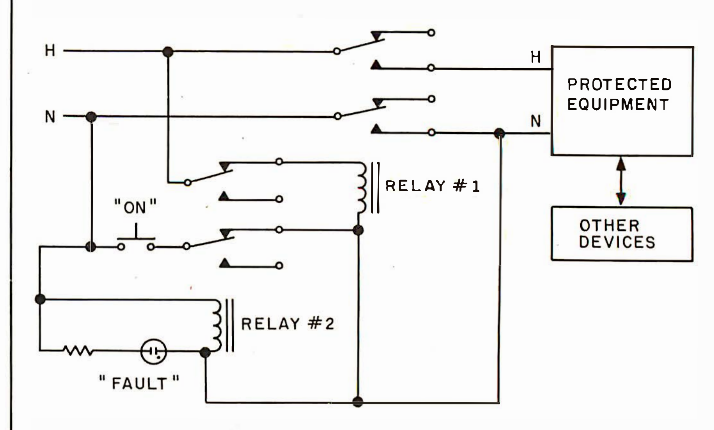
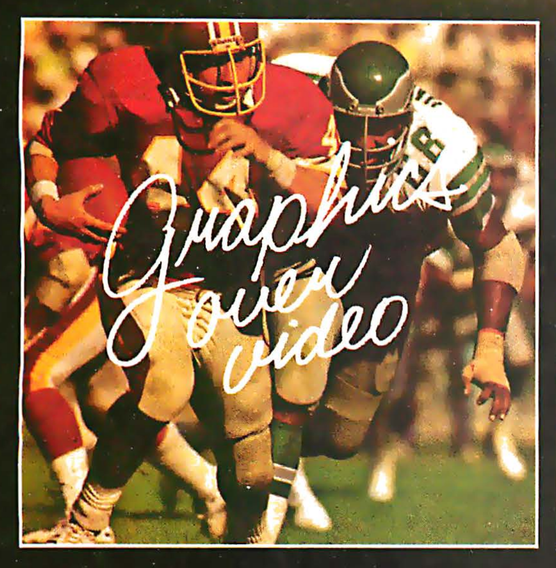
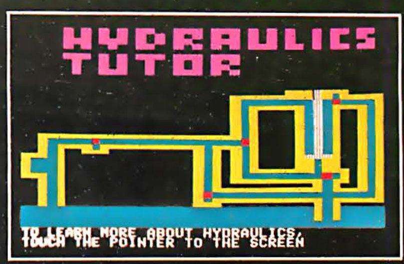


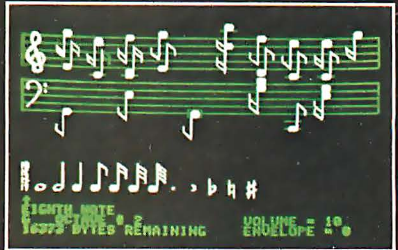
Figure 1: *Steven Schafer's power-line protection circuit. The line marked H is the hot side of the power line; the line marked N is the neutral side of the power line. The resistor in series with the neon lamp should have a value of 100 k ohms.*

Circle 64 on inquiry card. ⟶













VIDEO DATA PROCESSOR
Called the VDP, comes complete with 16K memory, its own color text and graphics generator and is designed to superimpose its graphics and text over incoming video signals from video tape, video disk, TV camera, Apple Video or Broadcast • Color text and graphics on an independent screen • Video titling or video interactive training uses. It's like your own TV station, works with OUR Light Pen too! Available directly from Symtec at $1500.00.

SPECIAL PROBLEMS
We can help. Symtec does custom engineering, fabrication, hardware and software design for microprocessor. Beginning at $1500, these services can solve your custom application needs for industrial, scientific, medical, engineering or personal uses.

SUPER SOUND GENERATOR
Apple Music Power with a plus • 3 voices, 6 in stereo version • Noise generator • Independent control of volume, envelope and shape by channel • Full power, easy to use software to compose, edit, play in hi-res graphics, PLUS, input and output ports allow extra uses: • Printer interface • Remote ASCII or music keyboard interface • and, optional BSR X-10 Adapter is available. Suggested retail $159.95 mono, $259.95 stereo.

SYMTEC X-10 CONTROL
Now for the Apple II, a low cost control to link your computer to the BSR X-10 Home Control System. Control your home or office lighting and appliances • Energy management • Display lighting Security and more. Suggested retail $49.95.

LIGHT PEN
A professional quality, full feature light pen for the Apple II Computer • Hi-resolution — draw on the screen • X, Y and sensitivity adjustments — fits any standard TV • Sync adjustment for remote video source • Touch switch sets interface flag • Rugged metal case • Recommended by Apple. Complete, ready to go, the Symtec Light Pen is provided with software and documentation in Basic, Applesoft and machine code. Muse's Pilot II Language using the Symtec Light Pen is also available. The Light Pen is useable for graphics, games, education, exhibits, freedom from the keyboard. Suggested retail $249.95.



See your Apple Dealer for a demonstration of the Symtec Light Pen, Supersound Generator or Symtec Apple X-10 Control. Other products and services are available directly from Symtec. Apple is a trade mark of Apple Computer Inc. BSR System X-10 is a trade mark of BSR Ltd. Muse is the trade mark of Micro Users Software Exchange, Inc.



22223 Telegraph Rd., Southfield, Mich. 48034 P.O. Box 462, Farmington, Mich. 48024 313-352-1790

will latch relay 1 *on* and apply power to the load. The only way to defeat the circuit is to hold the push-button switch closed while inserting the power plug in the wall socket. ■

Making 6502 Indirect Subroutine Calls Efficient

Philip K Hooper, 5 Elm St, Northfield VT 05663

I enjoyed the article "Indirect Addressing for the 6502," by Kenneth Skier (January 1980 BYTE, page 118), and I would like to suggest some alternative techniques. These are based on the observation that once the subroutine of interest has finished executing, control may return directly to the original calling program rather than to the interim location holding the volatile address of the subroutine. Implementing this permits savings in both time and storage, as will be shown.

Approach A involves initially writing hexadecimal 4C (the JMP op code) into the first of three read/write memory locations, the second and third of which will be set dynamically to the actual address of the desired subroutine, as in Mr Skier's article. The subroutine will then be summoned correctly by a simple JSR to the read/write memory location containing the 4C. Return will be to the main program.

Approach B requires no initialization of read/write memory, although two consecutive bytes of read/write memory must be reserved for use as a pointer. The main program does require three additional bytes containing hexadecimal 6C (op code for JMP indirect) followed by the address, low byte first, of the read/write memory location reserved for the pointer. In use, the pointer will be loaded (as before) with the actual subroutine address, and a JSR to the byte containing the 6C will result in the correct location, execution, and return from the desired subroutine.

Table 1.

	Approach used in article	Approach A	Approach B
Time overhead in μs	24 (JSR JSR RTS RTS)	15 (JSR JMP RTS)	17 (JSR JMPI RTS)
Bytes needed to do initialization	8 or 10	4 or 5	0
Additional bytes of program memory	0	0	3
Bytes of read/write memory required	4	3	2
Bytes required by stack	4	2	2

Table 1 summarizes the storage and time overhead requirements of these three JSR(I) techniques. For sheer speed, approach A performs best, while approach B can save two or three bytes, at a cost of two cycles per invocation. ■

Michael Fallgatter, 514 Bethesda Ct, Waukesha WI 53186

The article "Indirect Addressing for the 6502," by Kenneth Skier (referenced above), was most interesting, but I would like to point out that, in the case of indirect transfers to subroutines, a much faster-running linkage is possible. Rather than using the linkage routine:

```
JSR    variable address
RTS
```

the linkage using the 6502 indirect-jump command

```
JMP    variable pointer
```

produces the same result, takes less memory, and cuts the time required for the transfer of control by over 50%, from thirty-eight to eighteen machine cycles. Using this technique and assuming a table of subroutine addresses residing in a single page of memory, the listings in Mr Skier's article become those shown here.

Listing 1: *Initiate zero-page bytes*

```
LDA  #$6C                Write JMP indirect
STA  zero-page byte #1   via pointer to subroutine
                         address table
LDA  #$table page
STA  zero-page byte #3
```

Listing 2: *Transfer from main program*

```
LDX  subroutine #-pointer to address in table
STX  zero-page byte #2
JSR  zero-page byte #1
```

Listing 3: *Zero-page linkage routine to create subroutine call*

```
STX  zero-page byte #2
JMP  indirect, via subroutine address table
```

Listing 4: *Simulate indirect subroutine jump*

```
LDX  subroutine #
JSR  CALL SUBROUTINE(X)
```

Finally, since no indexed instructions are involved, the A register could be used instead of X. Also, there is a very minimal memory and execution-time penalty paid for using a nonzero page for the transfer routine. ■

Technical Forum is a feature intended as an interactive dialog on the technology of personal computing. The subject matter is open-ended, and the intent is to foster discussion and communication among readers of BYTE. We ask that all correspondents supply their full names and addresses to be printed with their commentaries. We also ask that correspondents supply their telephone numbers, which will not be printed.

Machine Problem Solving, Part 1:

Trial-and-Error Search, A Mechanical Plan to Save the Missionaries

Professor Peter W Frey
Northwestern University
Cresap Neuroscience Laboratory
2021 Sheridan Rd
Evanston IL 60201

Modern computers are famous for their number-crunching ability. Their facility at inverting a 60 by 60 matrix or at solving a set of linear differential equations is truly impressive. In fact, machines are so good at solving numerical problems that most of us take these skills for granted.

Computers are also useful as general-purpose control devices. Many personal-computing enthusiasts enjoy impressing their neighbors with their machine's ability to control lights, water sprinklers, and burglar alarms, and to take telephone calls and regulate the furnace. Homes of the future will be completely computerized.

The computer also makes an excellent bookkeeper: faithfully recording financial transactions, maintaining mailing lists, and generating timely reminders for important meetings. Personal computers also provide many hours of entertainment for their owners with games of manual dexterity, games of chance, and simulated battles among the stars or in dark dungeons. These many uses provide a clear rationale for the rapidly developing popularity of the personal computer.

The most exciting application of the computer lies in still another direction. It is as a *thinking machine* that the modern computer truly sparks our imagination. When faced with a problem that has no easy numerical solution, men have typically discarded their mechanical calculators and put on their proverbial thinking caps. For this type of problem, the human brain has always been superior to mechanical devices. An immense amount of respect for the human brain can be gained by trying to program a computer to select the best move in a game like chess. Even a multimillion-dollar mainframe computer turns out to be a woodpusher when asked to compete against a skilled human player.

Solutions by Searching

When machines confront nonnumerical problems, their primary weapon in finding a solution is to examine a vast labyrinth of potential outcomes in search of one which satisfies the desired conditions. Although this approach is not very elegant, it is, in fact, highly similar to that used by humans. The noted psychologist Donald Campbell (see reference 1) observed that trial-and-error search plays a key role in human problem solving: "a blind-variation-and-selective-survival process is fundamental to all inductive achievements, to all genuine increases in knowledge, to all increases in fit of system to environment."

It is as a *thinking machine* that the modern computer truly sparks our imagination.

Campbell also concluded that specialized problem-solving skills such as those observed in an experienced surgeon or airline pilot are "inductive achievements achieved originally by a blind-variation-and-selective-survival process." Thus, trial-and-error search provides the cornerstone for human efforts in acquiring new knowledge.

Search is even more important in solving problems by computer. With most problems, humans have background information which can be successfully employed to direct the solution process. Machines generally lack this. Problem solving by computer usually requires that all relevant facts be discovered during the solution process. This important difference between human and machine problem solvers has been addressed by recent efforts in artificial intelligence. By developing specialized information libraries, the computer scientist has created search programs which are reasonably competent at tasks such as diagnosing medical problems or developing three-dimensional models for complex chemical structures. For



A NEW MASTERPIECE IN PRINTERS

The MODEL 800 MST is certainly pleasing to look at, but its true beauty lies beneath the surface. A glimpse at its features reveals why it is rapidly becoming the most sought after printer in the world . . .

- Four standard interfaces:
  - RS-232 (15 baud rates)
  - Centronics compatible parallel
  - IEEE-488
  - 20ma current loop
- Six line densities: 64, 72, 80, 96, 120, 132
- 100 CPS at all six densities
- Unidirectional or bidirectional printing
- Sixteen horizontal and ten vertical tabs
- Elongated characters in all six densities
- 1920 character buffer
- Uses either perforated or roll paper
- Fully adjustable tractors to 9½″
- Auto self-test
- Up to 10 character fonts
  - Standard 96 character ASCII
  - User defined character font
  - Provision for up to eight additional fonts
- Dot resolution graphics in six densities
- Variable line spacing control from 0 to 64 dots in half-dot increments
- Auto form-feed for any form length at any line spacing
- Heavy-duty all aluminum chassis
- 110vac or 220vac, 50/60Hz.
- 100 million character printhead
- Measures only 15″ wide, 3″ high, and 11″ deep
- Weighs only 15 lbs.

. . . . . but maybe its most attractive feature is the price . . . . . $699.00.

base 2 inc. P.O. BOX 3548 FULL., CAL. 92634 / (714) 992-4344

most problem-solving efforts, however, it is much easier to emphasize search rather than sophisticated pattern matching.

Games as Problems

Games and puzzles provide excellent sample problems. Marvin Minsky states that "it is not that the games and mathematical problems are chosen because they are clear and simple; rather it is that they give us, for the simplest initial structures, the greatest complexity, so that one can engage some really formidable situations after a relatively minimal diversion into programming." (See reference 2.) Man's fascination with intellectual games is not a new phenomenon. The Dutch scholar Huizinga suggested many years ago that the human race should have been named *homo ludens* (the game player) rather than *homo sapiens*.

There are two important aspects of playing a game or solving a puzzle. The first consists of representing the problem in a way that permits efficient analysis. The second involves devising a search technique which is capable of finding a solution. The first task, finding a good way to represent the problem, is usually the key to an elegant solution. Unfortunately, few guidelines exist that provide a mechanical rule for developing a good representation. For this reason, problem representation generally must be devised individually for each game or puzzle by the human programmer.

The situation is quite different in respect to the search process. In this case, there are well-developed principles that have proven useful in many different problem areas. My purpose in this article will be to focus on the search process and to consider general techniques that have broad applicability.

The most basic type of search is called the trial-and-error search.

Trial-and-Error Search

The most basic type of search process is called *trial-and-error search*. In this case, the problem solver examines various operations until a sequence is found that leads to a solution. In primitive implementations, the different options are considered haphazardly rather than being ordered according to a specific plan. To demonstrate this approach, we will develop a solution for the missionaries-and-cannibals problem.

In its traditional form, this problem involves three missionaries and three cannibals who are located on one bank of a river and wish to cross. A boat is available which will hold two people and which can be navigated by one or two people. The special restriction that makes the problem interesting is that the sequence of river crossings must never result in an arrangement where the cannibals outnumber the missionaries on either bank. If the missionaries are outnumbered, their life expectancy will be immediately and permanently shortened.

In determining the number of individuals on each bank, the persons in the boat when it reaches shore are considered to be residents of that bank. The object for the problem solver is to develop a schedule of river crossings which transports the entire party across without losing any missionaries.

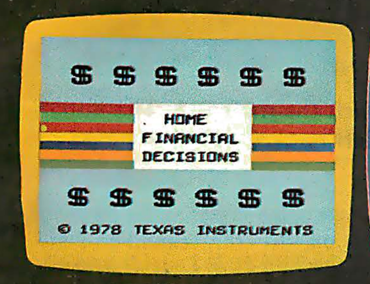
Representing the Problem

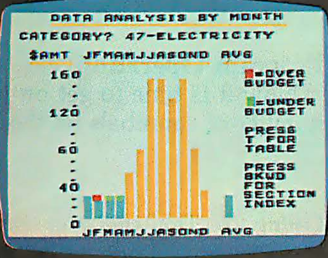
The first step in addressing this problem is to find a representation that is compatible with a machine problem-solving approach. For our effort, we would like to write a program in Level II BASIC for the Radio Shack TRS-80 computer. This machine is widely available and has more than enough power to solve this puzzle. We will consider the problem in terms of discrete *states* and discrete *operations*. We will not concern ourselves with the details of paddling a boat across a river, but rather with the executive decisions, ie: who is to be in the boat on each journey across.

The *state space* will consist of a description of the number and types of occupants on each bank before the boat makes a crossing or after a crossing is completed. We will employ a shorthand notation which represents a missionary by the letter M, a cannibal by the letter C, the boat by the symbol < = >, and the river by two vertical lines. Therefore, the character sequence CCMM | < = > |CM indicates that there are two cannibals and two missionaries on the left bank of the river and one cannibal, one missionary, and the boat on the right bank. This notation is adequate to describe all possible states of the problem.

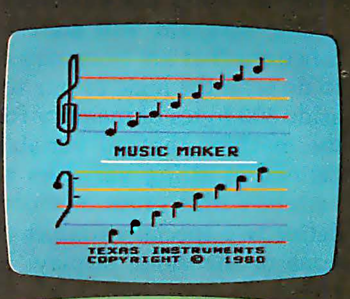
The *operations* (ie: legal moves) we can perform to transpose one state into another are quite limited in number. In fact, there are a maximum of five operations that can be used, and often only a subset of these will be feasible. The five operations consist of transporting (1) one

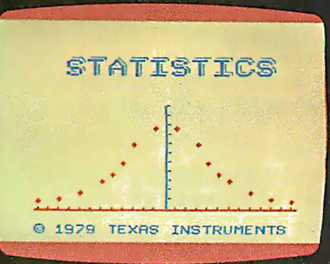
Announcing Texas Instruments Author Incentive Program... win up to $3,000.

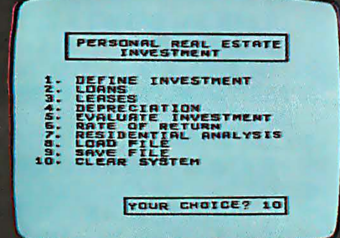


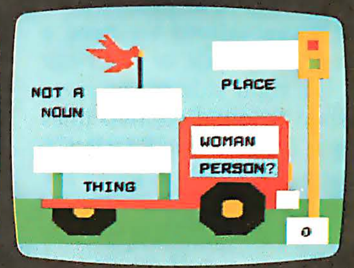


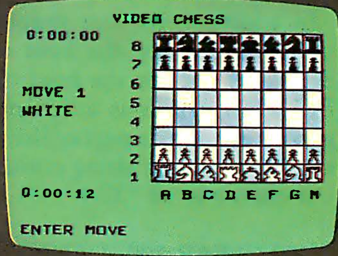












Texas Instruments is looking for unique home computer programs. If you have some, we can help you turn them into profit makers. To begin with--you could win up to $3,000. You'll still own the programs...we may help you sell them.

One of the most exciting things about the home computer revolution is discovering the many ways a computer can be used.

If you've been working with small computers for a while, chances are you've developed some innovative application programs. This is your chance to put them to work — for a profit.

Texas Instruments is looking for quality programs. We've created an Author Incentive Program to make it worth your while. The award for the top program will be $3,000. And there are five $1,000 awards, plus twenty $500 awards. All winners will be recognized with national publicity. Even if you don't receive one of these monetary awards, we may see enough market potential for your program to help you develop it and sell it.

We want programs that offer real utility and lasting value. Programs that are self-teaching, that communicate on human terms. After all, the TI Home Computer was designed to be the first home computer the whole family can use.

TI is interested in education, personal finance and technical or managerial programs for professionals. Home management programs, hobby and simulation programs. We prefer that your submissions exclude entertainment packages.

Your entry can be a program you've created for use on the TI-99/4 or other microcomputers — in any high-level language, from Pascal and BASIC to FORTRAN or COBOL — or even assembly language. All the way up to 48K RAM.

Keep in mind that programs for the TI Home Computer can incorporate high-quality color graphics, music and sound effects, and TI's remarkably-human synthesized speech.

To submit an entry, call the toll-free number below or use the reader service card in this magazine. We'll send you an entry submission form plus full details. *Please don't send anything until you receive and fill out this entry form.*

Programs must be in by November 15, 1980 — so get your entry form soon.



For an entry form, call 1-800-858-4565.

Call between 8 a.m.-4:30 p.m. CDT, Mon-Fri. In Texas call 1-800-692-4279.

Offer void where prohibited by law.
Author Incentive Program not open to TI employees, TI consultants and contractors or their families.

TEXAS INSTRUMENTS
INCORPORATED

Circle 69 on inquiry card.

221085

cannibal, (2) two cannibals, (3) one missionary, (4) two missionaries, or (5) one cannibal and one missionary.

To execute one of these operations in a particular direction, the boat must be located on the departure bank. In addition, an operator cannot be applied if the appropriate individuals are not present on the departure bank. For example, we cannot move two missionaries from the left bank to the right bank if there are fewer than two missionaries on the left bank at that point in time.

Programming the Problem

Our program will start with a few "housekeeping" functions that are necessary even though they have little to do with the logic of our solution. It is necessary to set aside 300 bytes of memory for string variables, to inform the machine that all variables that are not specifically defined as string variables are to be treated as integer variables (this saves memory and speeds execution), to define two special variables (X$ and Y$) for clearing sections of the video display, and to blank out the entire screen.

In addition, for our graphic presentations we need a representation for the boat on the left side of the river (BL$) and one for the boat on the right side of the river (BR$). All of this is accomplished in our first two lines (given here and as part of listing 1; the function STRING$ (*n*, *"X"*) returns a string consisting of *n* symbols using the first character of *"X"*):

```
100 CLEAR 300: DEFINT A-Z:
    Y$=STRING$(40," "): CLS
110 X$=STRING$(9," "):
    BL$="<=>"+X$:BR$=X$+"<=>"
```

It is also helpful to set up a few arrays to store essential information. We need to know the position of the boat, the number of cannibals on the left bank, and the number of missionaries on the left bank after each river crossing. This information will be retained in arrays B, C, and M. We also need to remember which of the crossing options (1 cannibal, 2 cannibals, 1 missionary, etc) we have considered at each choice point in our crossing sequence. This information is stored numerically by array D and for graphic purposes in string array MV$. Finally, we need to specify the crossing options with respect to the cannibals, array CT, and the missionaries, array MT. The TRS-80 is instructed to establish these arrays in line 120:

```
120 DIM B(30), C(30), CT(5), D(30),
    M(30), MT(5), MV$(30)
```

To make the program more interesting, we will generalize the problem so that the number of travelers can vary from four to sixteen. The number of travelers will be represented by the variable N which can be specified by the user:

```
130 PRINT@526, "NUMBER OF TRAVELERS
    (4 TO 16)";: INPUT N
140 CLS: IF N<4 OR N>16 THEN 130
```

Line 140 makes sure that the value entered for N is in the proper range. This is important with the TRS-80 because keyboard bounce is apt to provide a value like 122 when we intended 12. The program would experience difficulties if it attempted execution with N set at a value of 122.

Next, we set the stage properly. First we need a title (line 150) and then we need a river for our travelers to cross (line 160):

```
150 PRINT@24, "MISSIONARIES AND
    CANNIBALS";
160 FOR K=4 TO 43: SET (58,K): SET (85,K):
    NEXT K
```

Program Operation

Now it is time to get on with the main act. The initial number of cannibals on the left bank (CI) is computed as

Listing 1: *Trial-and-error solution to the cannibals-and-missionaries problem, written for the TRS-80 in Level II BASIC.*

```
100 CLEAR 300: DEFINT A-Z: Y$=STRING$(40," "): CLS
110 X$=STRING$(9," "): BL$="<=>"+X$:BR$=X$+"<=>"
120 DIM B(30), C(30), CT(5), D(30), M(30), MT(5), MV$(30)
130 PRINT@526, "NUMBER OF TRAVELERS (4 TO 16)";:
    INPUT N
140 CLS: IF N<4 OR N>16 THEN 130
150 PRINT@24, "MISSIONARIES AND CANNIBALS";
160 FOR K=4 TO 43: SET(58,K): SET(85,K): NEXT K
200 CI=INT(N/2): MI=N-CI: BP=1: I=0
210 CL=CI: CR=0: ML=MI: MR=0
220 CT(1)=2: CT(2)=1: CT(3)=0: CT(4)=0: CT(5)=1
230 MT(1)=0: MT(2)=0: MT(3)=2: MT(4)=1: MT(5)=1
300 GOSUB 2000: GOSUB 1000
310 C(I)=CL: M(I)=ML: B(I)=BP
320 IF ML=0 AND CL=0 THEN 700
330 FOR K = 1 TO 800: NEXT K
340 I=I+1: D(I)=0
350 D(I)=D(I)+1: IF D(I)>5 THEN 600
360 IF BP=-1 THEN 380
370 IF CL<CT(D(I)) OR ML<MT(D(I)) THEN 350 ELSE 390
380 IF CR<CT(D(I)) OR MR<MT(D(I)) THEN 350
390 CL=CL-BP*CT(D(I)): CR=CI-CL
400 ML=ML-BP*MT(D(I)): MR=MI-ML: BP=-BP
410 IF ML>0 AND CL>ML THEN 500
420 IF MR>0 AND CR>MR THEN 500 ELSE K=0
430 IF CL=C(K) AND ML=M(K) AND BP=B(K) THEN 500
440 K=K+1: IF K<I THEN 430
450 A$=STRING$(CT(D(I)),"C"): B$=STRING$ (MT(D(I)),"M")
460 IF BP=-1 THEN MV$(I)=A$+B$+"->"
    ELSE MV$(I)="<-"+A$+B$
470 GOTO 300
500 BP=-BP: CL=CL+BP*CT(D(I)): CR=CI-CL
510 ML=ML+BP*MT(D(I)): MR=MI-ML: GOTO 350
600 PRINT@960, "BACK UP AND TRY SOMETHING ELSE";
610 I=I-1: IF I<1 THEN PRINT@ 960, Y$;: GOTO 800
620 CL=C(I-1): CR=CI-CL: ML=M(I-1): MR=MI-ML
630 BP=B(I-1): GOSUB 2000: GOSUB 1000
640 FOR K=1 TO 800: NEXT K
650 PRINT@ 960, Y$;: GOTO 350
700 PRINT@ 960, "SUCCESS";: GOTO 700
800 PRINT@ 64, X$;: PRINT@ 960, "FAILURE";: GOTO 800
1000 IF I=0 THEN RETURN
1010 FOR K=1 TO 14: PRINT@ K*64, X$;: NEXT K
1020 S=I-13: IF S<1 THEN S=1
1030 FOR K=S TO I: J=K-S+1
2000 Z$=STRING$(8-CR," "): CR$=STRING$(CR,"C")+Z$
2010 Z$=STRING$(8-CL," "): CL$=Z$+STRING$(CL,"C")
2020 Z$=STRING$(8-MR," "): MR$=STRING$(MR,"M")+Z$
2030 Z$=STRING$(8-ML," "): ML$=Z$+STRING$(ML,"M")
2040 IF BP=1 THEN B$=BL$ ELSE B$=BR$
2050 PRINT@ 468, CL$;: PRINT@ 492, CR$;: PRINT@ 478, B$;
2060 PRINT@ 532, ML$;: PRINT@ 556, MR$;: RETURN
```

is the initial number of missionaries on the left bank (MI). We will assume an equal number of missionaries and cannibals when N is even and an extra missionary when N is odd. (If there were an extra cannibal at the beginning, our problem would end before we had a chance to try our first crossing.)

The position of the boat will be indicated by the variable BP. When the boat is on the left bank, BP will have a value of 1. A value of −1 will indicate that the boat is on the right bank. The index reflecting the number of crossings (I) is set to zero and the values for the variables indicating the number of cannibals on the left bank (CL), the number of cannibals on the right bank (CR), the number of missionaries on the left bank (ML), and the number of missionaries on the right bank (MR) are also initialized:

```
200 CI=INT(N/2): MI=N-CI: BP=1: I=0
210 CL=CI: CR=0: ML=MI: MR=0
```

We also wish to specify each crossing option by specifying the number of cannibals (CT) and the number of missionaries (MT) who are transported:

```
220 CT(1)=2: CT(2)=1: CT(3)=0: CT(4)=0:
     CT(5)=1
230 MT(1)=0: MT(2)=0: MT(3)=2: MT(4)=1:
     MT(5)=1
```

The main loop of our program begins with calls to two subroutines which handle the graphic display. One subroutine (which appears later in this article at line 1000) displays an up-to-date list of the crossings attempted so far. The other subroutine (line 2000) provides a pictorial representation of the current position of the missionaries, cannibals, and boat. These routines are not essential for solving the problem, but they add a nice touch to the program and allow the user to watch the machine's "thought processes." These subroutines are invoked at line 300:

```
300 GOSUB 2000: GOSUB 1000
```

Each time through the loop, it is necessary to make a permanent record of the current status of our principal characters:

```
310 C(I)=CL: M(I)=ML: B(I)=BP
```

and then to check to see if the problem has been solved:

```
320 IF ML=0 AND CL=0 THEN 700
```

If not, we create a brief delay so that the human observer will not miss any of the action:

```
330 FOR K=1 TO 800: NEXT K
```

and then get about our main business, examining the feasibility of making a particular crossing by incrementing I by one and initializing D(I), which keeps track of the particular crossing option we are trying at each step I in the crossing sequence. The variable D(I) is then incremented and a test is made to see if we have exhausted the available options:

```
340 I=I+1: D(I)=0
350 D(I)=D(I)+1: IF D(I)>5 THEN 600
```
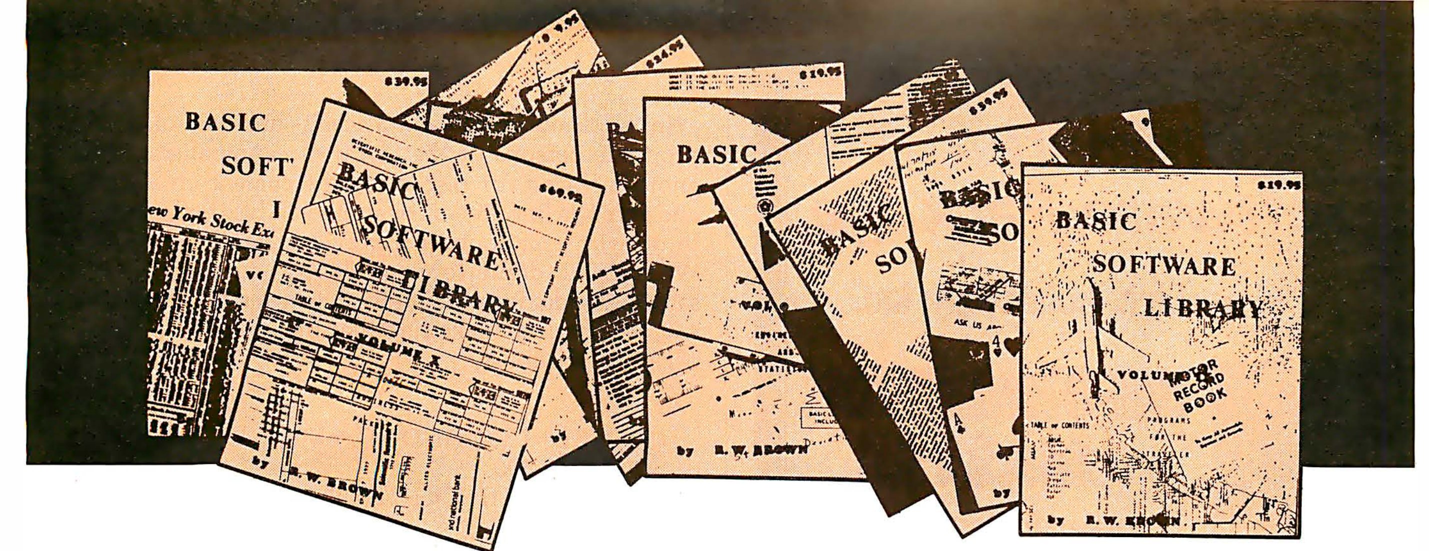
Testing Options

If all options have been tried without success, the machine is directed to line 600 and asked to execute a back-up procedure that tries another option at an earlier position in the sequence. If we still have a viable option at this previous value of I, we continue by examining the particular crossing option which is indicated. First, we determine the location of the boat (line 360), then make sure we have a sufficient number of missionaries and cannibals on the departure bank to carry out the indicated crossing (lines 370 and 380), and finally we make the crossing (lines 390 and 400):

```
360 IF BP=-1 THEN 380
370 IF CL<CT(D(I)) OR ML<MT(D(I))
       THEN 350 ELSE 390
380 IF CR<CT(D(I)) OR MR<MT(D(I)) THEN 350
390 CL=CL-BP*CT(D(I)): CR=CI-CL
400 ML=ML-BP*MT(D(I)): MR=MI-ML:
       BP=-BP
```

Next, we check to make sure that the cannibals do not outnumber the missionaries on either bank. If they do, we go to line 500 to reverse the crossing, and then to line 350 to select another crossing option:

```
410 IF ML>0 AND CL>ML THEN 500
420 IF MR>0 AND CR>MR THEN 500 ELSE K=0
```



BASIC SOFTWARE LIBRARY

NOW ★ 10 ★ Volumes and Growing

IS SPONSORING A

$10,000.00 Give Away

WHY Pay hundreds of dollars for Software that does Not work when WE offer the BEST available Software for only a few dollars a program. And what is better OURS WORKS!

We have over 100,000 in circulation since 1975 and we are still around and That's more than Anyone else can say. We used to sell hundreds of programs individually, the programs in Volume X were sold for several years at over $10,000, in Volume III for over $6,000 but a few years ago we decided to promote software to the mass public and it was an instant success.

For Homeowners, Businessmen, Engineers, Hobbyists, Doctors, Lawyers, Men and Women

Vol. I $24.95
Business & Personal Bookkeeping Programs
Bond
Building
Compound
Cyclic
Decision 1
Decision 2
Depreciation
Efficient
Flow
Installment
Interest
Investments
Mortgage
Optimize
Order
Pert Tree
Rate
Return 1
Return 2
Schedule 1

Games & Pictures
Animals Four
Astronaut
Bagel
Bio Cycle
Cannons
Checkers
Craps
Dogfight
Golf
Judy
Line Up
Pony
Roulette
Sky Diver
Tank
Teach Me

A. Newman
J.F.K.
Linus
Ms. Santa
Nixon
Noel Noel
Nude
Peace
Policeman
Santa's Sleigh
Snoopy
Virgin

Vol. II $24.95
Binomial
Chi-Sq.
Coeff.
Confidence 1
Confidence 2
Correlations
Curve
Differences
Dual Plot
Exp-Distri
Least Squares
Paired
Plot
Plotpts
Polynomial Fit
Regression
Stat 1
Stat 2
T-Distribution
Unpaired
Variance 1
Variance 2
XY.
APPENDIX A
Beam
Conv.
Filter
Fit
Integration 1
Integration 2
Intensity
Lola
Macro
Max. Min.
Navaid
Optical
Planet
PSD
Rand 1
Rand 2
Solve
Sphere Trian
Stars
Track
Triangle
Variable
Vector

Vol. III $39.95
Billing
Inventory
Payroll
Risk
Schedule 2
Shipping
Stocks
Switch

Vol. VI $49.95
Mini-Ledger
Payroll
A/R
Inventory
Peprec.
Ledger

Vol. VII $39.95
Chess
Medbil
Wdproc
Utility

Vol. IV $9.95
Bingo
Bonds
Bull
Enterprise
Football
Funds 1
Funds 2
Go-Moku
Jack
Life
Loans
Mazes
Poker
Popul
Profits
Qubic
Rates
Retire
Savings
SBA
Tic-Tac-Toe

Vol. V $9.95
Andy Cap
Baseball
Compare
Confid 10
Descrip
Differ
Engine
Fourier
Horse
Integers
Logic
Playboy
Primes
Probal
Quadrac
Red Baron
Regression 2
Road Runner
Roulette
Santa
Stat 10
Stat 11
Steel
Top
Vary
Xmas
APPENDIX B

Vol. VIII • $19.95
1040-Tax
Balance
Checkbook
Instol 78
Deprec 2
APPENDIX C
Favorites

Vol. IX $19.95
Auto
Cypher
Hurrtrac
ID
Lorana
Map
Navigate
Omega
Patterns
Radar
RDF

Vol. X $69.95
Intro.
A/R
A/P
Mer Inv
Check
Assets
Payroll
Bal Sh
P/L
Year End
Data Base
Tax Up
Basic St.

Volume VI — Disk programs are compatible with TRS-80 disk basic

The disk programs in Volumes VI, VII and X are written in (CP/M) M Basic and Disk Extended Microsoft Basic. Other programs written in 8K Basic.

FIRST DRAWING — September 11, 1980 and every week thereafter until December 18, 1980. Winners will be notified within one week. For a list of winners send a self-addressed stamped envelope with a request for the winners list.

No PURCHASE Necessary, to enter send name & address on a 3 x 5 card. You are automatically entered every time you make a purchase from us. Void where prohibited by LAW.

Unconditional Money Back Guarantee.

Add $1.50 per volume handling, all domestic shipments sent U.P.S. except APO and P.O. Box which go parcel post. Foreign orders add $6.00/volume for air shipment and make payable in U.S. dollars only.

AVAILABLE AT MOST COMPUTER STORES
Master Charge and Bank Americard accepted.
Our Software is copyrighted and may not be reproduced or sold.

Unlike others we have NOT raised our prices in five years

KEMCO, LTD.
P.O. Drawer 2208L Petersburg, VA 23803

Circle 72 on inquiry card.

IN GERMANY
Ing. W. Hofacker, GmbH
Holzkirchen, W. Germany

IN HOLLAND
Nanton Press B.V.
Bilthoven, Holland

OVER 116,000 IN USE TODAY

In addition to an insufficient number of the appropriate persons or the threat of cannibalism, there is another reason for discarding the current crossing plan and going to line 350 to try another. This third reason has to do with repetition of a previous state of the system. We have no desire to create loops which transport the same individuals back and forth forever. In lines 430 and 440, we check to make sure that the current state has not occurred previously:

```
430 IF CL=C(K) AND ML=M(K) AND BP=B(K)
    THEN 500
440 K=K+1: IF K<I THEN 430
```

If our current crossing option passes these three tests, then we are ready to proceed. The crossing is recorded for posterity's sake; then we jump to line 300 to start the process once again:

```
450 A$=STRING$(CT(D(I)),"C"):
    B$=STRING$(MT(D(I)),"M")
460 IF BP=-1 THEN MV$(I)=A$+B$+"->"
    ELSE MV$(I)="<-"+A$+B$
470 GOTO 300
```

Backing Up

This completes the main loop of the program. We have a few loose ends which need to be taken care of before the job can be considered finished. When we found that a crossing option was not feasible either because of cannibalism (lines 410 and 420), or because of repetition of a previous position (lines 430 and 440), the machine was instructed to go to line 500 and reverse its previous move. Line 500 must therefore exist as follows:

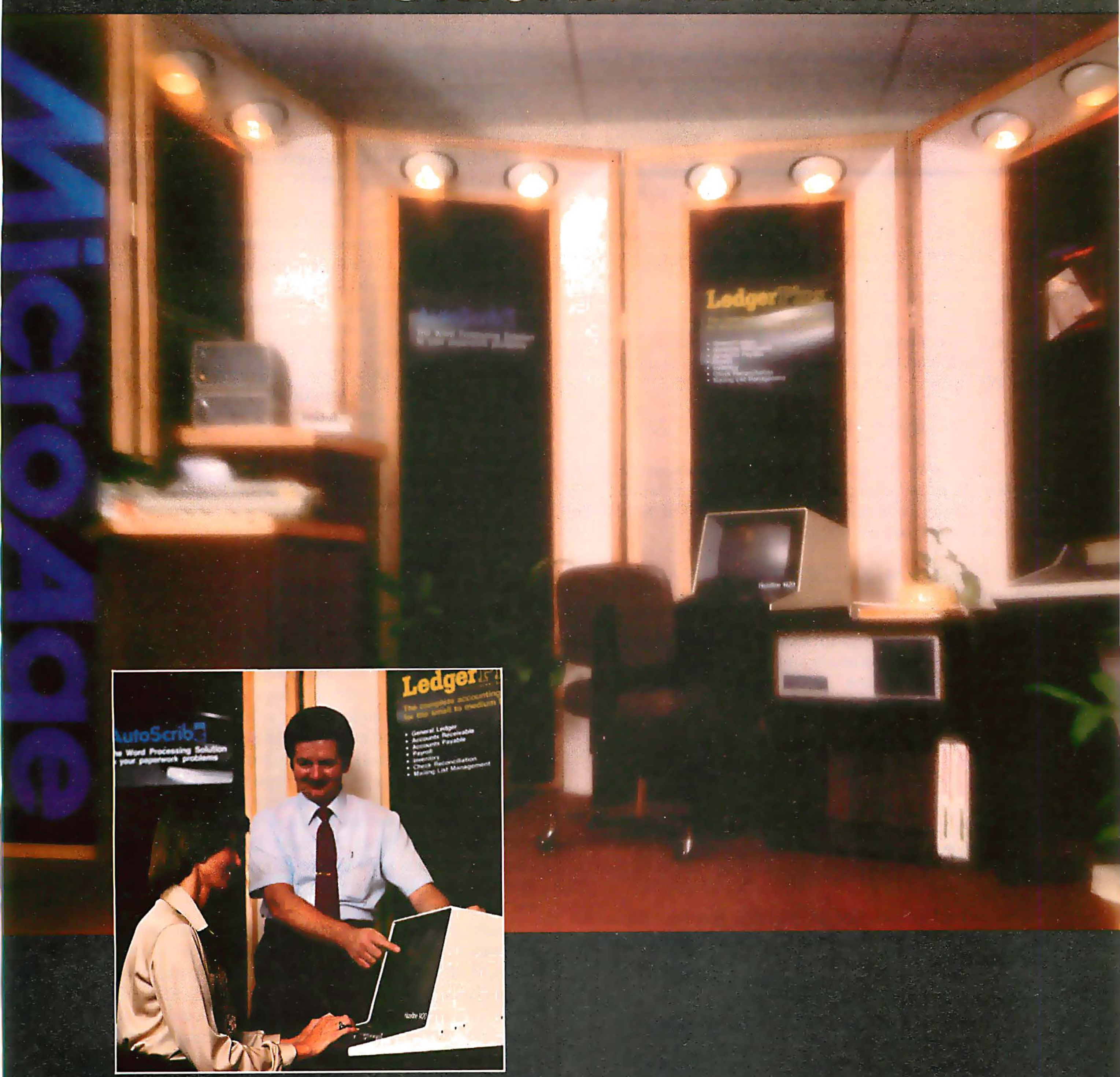
```
500 BP=-BP: CL=CL+BP*CT(D(I)):
    CR=CI-CL
510 ML=ML+BP*MT(D(I)):
    MR=MI-ML: GOTO 350
```

After returning to line 350 to try another crossing, we may find that all five options have been exhausted. If so, it is time to back up our search and try something different at an earlier point in the crossing sequence. The back-up instructions start at line 600:

```
600 PRINT@960, "BACK UP AND TRY
    SOMETHING ELSE";
610 I=I-1: IF I<1 THEN PRINT@ 960,
    Y$;: GOTO 800
620 CL=C(I-1): CR=CI-CL: ML=M(I-1):
    MR=MI-ML
630 BP=B(I-1): GOSUB 2000: GOSUB 1000
640 FOR K=1 TO 800: NEXT K
650 PRINT@ 960, Y$;: GOTO 350
```

The back-up procedure is a little tricky. First, we decrement I by 1, then we set the current status of our main characters to the way it was *before* we made the last crossing. Our objective is to examine another crossing option at the new value of I. To do this, the position we transform must be the situation as it existed before the

WHEN OPPORTUNITY KNOCKS ...



Open the door, and experience the dream. Your own business, the one you've always yearned for. No more limits on your creativity or earning potential. No more working for someone else.

If you're a successful computer professional and have access to some capital, chances are you could own a MicroAge Computer Store. MicroAge Computer Stores are built around a whole new concept of what a computer store should be. Designed to provide solutions, not just sell hardware.

MicroAge Computer Stores are firmly positioned in the business and professional marketplace. And as a MicroAge Computer Store owner, you'll be backed by one of the acknowledged leaders, industry pioneers in microcomputing. Contact the Director of Franchising today to receive a complete Franchise Information Package free of charge and at no obligation. Opportunity is knocking . . . you'll see what we mean.

MicroAge.
COMPUTER STORE

1425 W. 12th Place • Tempe, AZ 85281 • (602) 967-1421

A search program such as this one can be quite effective if the number of possible move combinations is not too large.

last move. The back-up procedure also calls our graphic routines (line 630), delays a bit for dramatic effect (line 640), and then erases the back-up message (line 650) before exiting for line 350.

There are two terminal conditions for the search process. If we move all the cannibals and missionaries across the river, our mission is successfully completed. This condition is detected by line 320 which directs the machine to line 700:

```
700 PRINT@ 960, "SUCCESS";: GOTO 700
```

If we back up to the point where I=0, then we have exhausted all possibilities and our search has failed. This state of affairs is tested in line 610 and if it holds, the machine is sent to line 800:

```
800 PRINT@ 64, X$;: PRINT@ 960, "FAILURE";:
     GOTO 800
```

This finishes our program except for specifying the two subroutines which maintain our video display. The first of these occurs at line 1000 and keeps an up-to-date listing of the crossing sequence:

```
1000 IF I=0 THEN RETURN
1010 FOR K=1 TO 14: PRINT@ K*64, X$;:
      NEXT K
1020 S=I-13: IF S<1 THEN S=1
1030 FOR K=S TO I: J=K-S+1
1040 PRINT@ J*64, K; " "; MV$(K);:
      NEXT K: RETURN
```

The second subroutine provides a graphic display of the current position of the boat and of all missionaries and cannibals:

```
2000 Z$=STRING$(8-CR," "):
      CR$=STRING$(CR,"C")+Z$
2010 Z$=STRING$(8-CL," "):
      CL$=Z$+STRING$(CL,"C")
2020 Z$=STRING$(8-MR," "):
      MR$=STRING$(MR,"M")+Z$
2030 Z$=STRING$(8-ML," "):
      ML$=Z$+STRING$(ML,"M")
2040 IF BP=1 THEN B$=BL$ ELSE B$=BR$
2050 PRINT@ 468, CL$;: PRINT@ 492, CR$;:
      PRINT@ 478, B$;
2060 PRINT@ 532, ML$;: PRINT@ 556, MR$;:
      RETURN
```

Limitations and Features

A search program such as this one can be quite effective if the number of possible move combinations is not too large. The missionaries-and-cannibals problem is an ideal example for this type of search because there is a limited number of options at each choice point. If there were many options at each choice point, a simple trial-and-error search might take a very long time to find a solution sequence. If there were a solution, however, it would find it.

The key features of this program are the I index and the D(I) array. If we use game terminology, the I variable indexes the move number (ie: first move, second move, third move, etc) and the D(I) array keeps track of which move option is currently being considered at each level I of the search. In the missionaries-and-cannibals problem, our program exhaustively considers the various move options. It accepts the first legal move option it can find at each level I of the search.

A move is legal unless it fails one of the three tests (insufficient passengers, lines 370 and 380; cannibalism, lines 410 and 420; or repetition, lines 430 and 440). The search continues forward until it reaches a level where none of the five possible move options are feasible. It then backs up until it can find a new move option at a lower level and then starts forward again. This is a simple yet powerful strategy.

Improving the Process

Our implementation of this strategy could be made considerably more "intelligent" if we gave some thought to the order in which crossings are considered. In lines 220 and 230, we define the five crossing options. We could reduce the number of back-ups by establishing one order of move consideration for trips across to the right bank and another order for trips back to the left bank.

The interested reader might enjoy looking at academic studies which have examined this issue in detail (see, for example, reference 3). Some minor modifications can increase the efficiency of the present program by a large factor. One strategy for implementing this idea consists of defining one set of crossing options for left-to-right movement (say lines 220 and 225) and another set of crossing options for right-to-left movement (say lines 230 and 235) and then selecting between the two depending on the value of BP.

Many problems require more direction to the search process if a solution is to be found in a reasonable amount of time. Next month, in the second part of this three-part article, we will consider a much more challenging endeavor, cryptarithmetic. Allen Newell, one of the pioneers in analyzing human thinking in terms of information-processing models, made extensive use of cryptarithmetic as a valuable research paradigm. We will develop a search program in TRS-80 Level II BASIC that is capable of solving all cryptarithmetic problems. ■

References

1. Campbell D T, "Blind Variation and Selective Survival as a General Strategy in Knowledge-processes," *Self-Organizing Systems*, edited by Yovits and Cameron, Pergamon Press, New York, 1960, pages 205 thru 231.
2. Minsky, M (editor), *Semantic Information Processing*, MIT Press, Cambridge MA, 1968, page 12.
3. Jeffries R, P G Polson, L Razran, and M E Atwood, "A Process Model for Missionaries-Cannibals and Other River-crossing Problems," *Cognitive Psychology*, 1977, volume 9, pages 412 thru 440.

BYTE's Bits

A Better Way to Indirectly Address the 6502

In the article "Indirect Addressing for the 6502," by Ken Skier in the January 1980 BYTE (page 118), there was an error in listings 2 and 3. Because absolute addresses occupy 2 bytes, the address of the *X*th subroutine will be in position 2*X* in the address table, not the *X*th. This problem can be corrected by storing the high address bytes in one table and the low-order bytes in another. With this structure the *X*th entry will correspond to the *X*th subroutine.

I would like to suggest two other methods of implementing indexed indirect jumps which are more efficient in terms of code length and execution time. The first method is that of vectoring: 3 bytes are reserved as the "vector." The first byte always contains a hexadecimal 4C (JMP). The target address is placed in the next 2 bytes and a JMP or JSR is then done to the vector, so that control passes to the selected module.

The second method, however, is the more effective and concinnate. Suppose that we wish to call routine *X*, and that the address table is structured as 2 rows: TBL.LO and TBL.HI. Consider the routine CALL.X, shown here as listing 1.

By doing a JMP or JSR to CALL.X an indexed indirect JMP or JSR will be effected to the *X*th routine. One point to be observed here is that the execution of a RTS instruction pops the stack into the program counter, and then increments it. Thus the addresses in the table must be one less than their actual value.

Listing 1

```
CALL.X    LDA TBL.HI,X     ;GET ADDRESS X, HIGH BYTE
          PHA              ;AND PUSH IT TO THE STACK
          LDA TBL.LO,X     ;GET ADDRESS X, LOW BYTE
          PHA              ;AND PUSH IT TO THE STACK
          RTS              ;GO TO ROUTINE X
```

Thomas Gettys, Co-editor
SYM-Physis
SYM-1 Users' Group
POB 315
Chico CA 95927

Notes on Attending a USUS Meeting

The first meeting of the USUS (UCSD System Users Society) was held in San Diego, California, on June 20 and 21, 1980. The meeting was called by SofTech Microsystems, then turned over to the approximately one hundred participants at the meeting. Speakers at the meeting included Carl Helmers and Ken Bowles. Organization, choosing a name, and the election of officers were the main formal goals. Jim Bandy was elected president, A Winsor Brown was elected vice-president, Chip Chapin was elected secretary, and Jon Bondy was elected treasurer. Informal accomplishments included the usual exchange of information which occurs between users of similar software. The next meeting of the USUS group will coincide with the Minicomputer and Microcomputer Conference and Exposition to be held on October 14, 15, and 16, 1980, in San Francisco, California. For further information, contact the secretary, Chip Chapin, at the following temporary address: UCSD System Users Society, attn: Chip Chapin, Secretary, 9494 Black Mountain Rd, San Diego CA 92126....CH■

APL Character Generator

John W Langner
411 Monterey Blvd Apt B
Hermosa Beach CA 90254

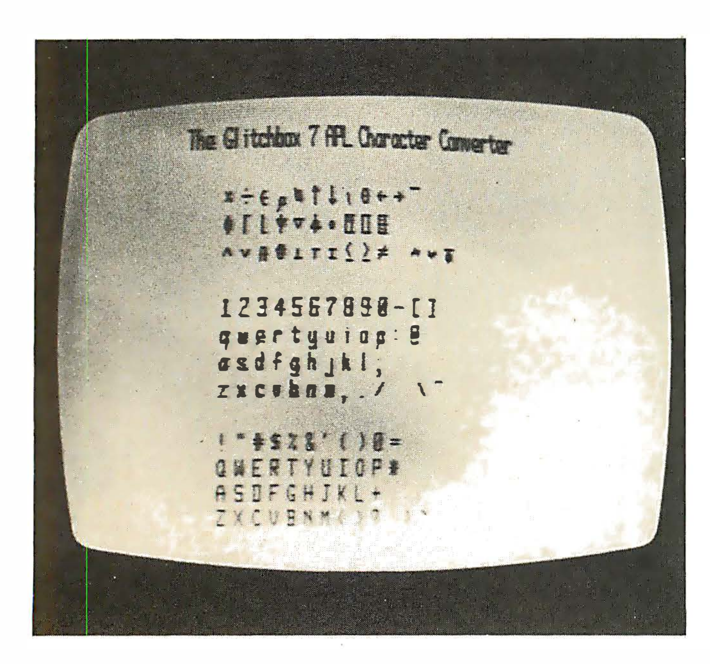


Photo 1: *Video screen display of the character set produced by the APL character-generator circuit described in this article.*

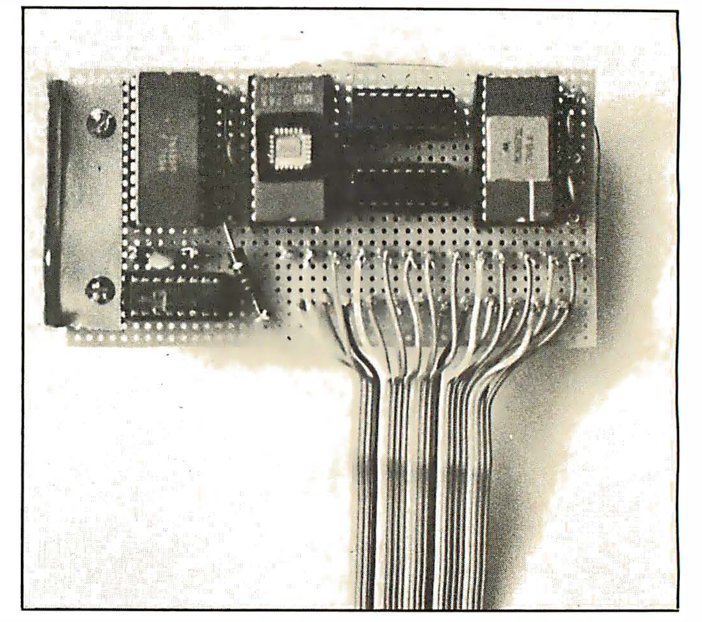


Photo 2: *The circuit of figure 1 as constructed on a small perforated circuit board.*

Many computer enthusiasts are beginning to use APL and are discovering the benefits of this powerful high-level language. Unfortunately, most personal computers are not equipped to generate the special APL characters.

Various solutions to this problem have been proposed, ranging from using inverse-video characters to using a programmable display that allows you to define any characters you want under program control.

Here is another solution. With the addition of only a few integrated circuits, and with only a single change in your present video interface, you can have the essential APL characters, including overstrikes. The circuit presented here should work with any video display using the popular MCM6571 character generator and can easily be adapted for others.

The first thirty-two positions in the MCM6571 are occupied by Greek letters and other seldom-used characters. The idea is to replace these with APL characters. After I listed the useful APL characters and

Author's Note:

Readers who wish to build this circuit but do not have access to an erasable programmable read-only memory (EPROM) programmer can obtain preprogrammed 2708s from the author for $20.



Maxell offers a way to stay ahead.

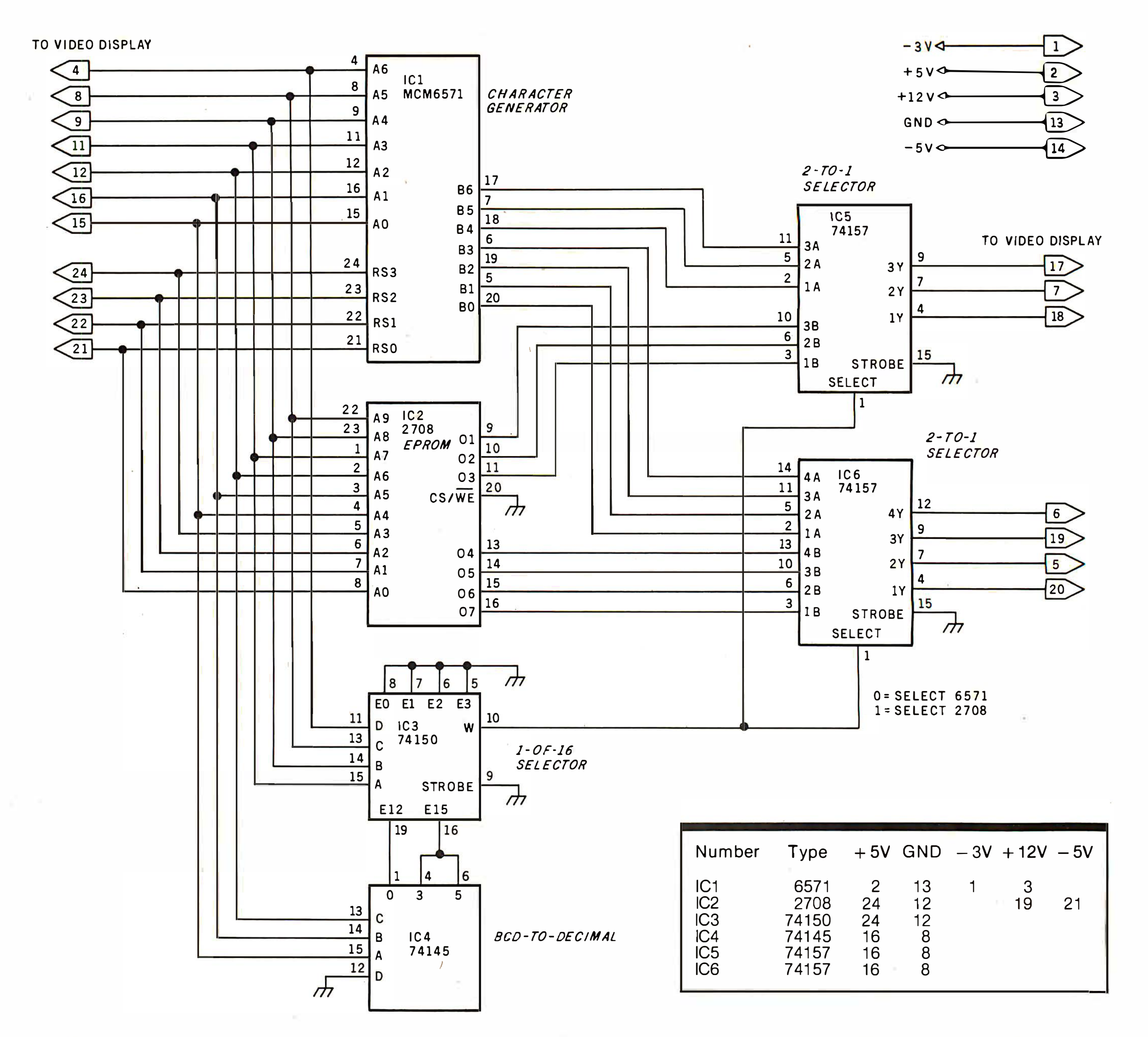
A Maxell 5¼" Mini-Disk will consistently let you maximize the capability of your system today. And as your involvement with it grows, tomorrow as well. Maxell Mini-Disks are all made with the same exacting 100% certification and critical dependability of the Maxell 8" Floppy Disk. So you know your 5¼" Maxell Mini-Disks meet or exceed the same ISO and Shugart specifications industry requires.

There are double density Maxell single and double-sided 5¼" Mini-Disks for soft and hard sector systems. And 8" Maxell Floppy Disks for every disk drive configuration. See your computer supply dealer or write to us for more information. If you are a computer products dealer, write for the growing opportunities Maxell Business Products Division offers you with our 8" Floppy and 5¼" Mini-Disks.



Maxell Corporation of America, Business Products Division, 60 Oxford Drive, Moonachie, N.J. 07074 Tel: 201-440-8020

Circle 78 on inquiry card.



Number	Type	+5V	GND	−3V	+12V	−5V
IC1	6571	2	13	1	3	
IC2	2708	24	12		19	21
IC3	74150	24	12			
IC4	74145	16	8			
IC5	74157	16	8			
IC6	74157	16	8			

Figure 1: *Schematic diagram of the character-generator circuit which is to be constructed on a small circuit board for connection to the main video display board by a multiconductor cable. All connections are made through a 24-pin dual-in-line plug that plugs into the socket vacated by the removal of the MCM6571 from the video display board. The MCM6571 socket must have −5 V potential applied to its pin 14; this is the only modification needed on the video display board itself. Adding this −5 V connection does not affect normal operation since pin 14 on the MCM6571 package is not connected inside. To get the { and } characters instead of the ⍲ and ⍱ characters, disconnect pin 16 of the 74150 device.*

eliminated those already found in the ASCII (American Standard Code for Information Interchange) character set, thirty-five remained to be implemented.

Most people can probably do without the braces and accent grave ({ } ‘) from the ASCII character set, so I replaced them. If you need to have the braces, you can substitute them for the ⍲ (NAND) and ⍱ (NOR) symbols.

The circuit to produce the APL characters is presented in figure 1. It contains the original MCM6571 character generator from the video interface and a 2708 erasable programmable read-only memory (EPROM) programmed as an APL character generator. The 74145 BCD-to-decimal decoder and 74150 1-of-16 data selector decide which character generator to select, and the 74157 noninverting 2-to-1-line data selectors act accordingly.

The circuit can be built on a small board and plugged into your video display with a short ribbon cable and a 24-pin dual-in-line plug. The only modification to your video interface is to connect −5 V to pin 14 of the character-generator socket. This will *not* affect normal operation because pin 14 is not connected inside the MCM6571.

The data that must be programmed into the 2708 is listed in table 1. The character codes that invoke the APL characters are shown in table 2. ■

Most small system users think all microcomputers are created equal. And they're right. If you want performance, convenience, styling, high technology and reliability (and who doesn't?) your micro usually has a price tag that looks more like a mini. It seems big performance always means big bucks. But not so with the SuperBrain.

Standard SuperBrain features include: twin double-density 5¼" drives which boast over 300,000 bytes of disk storage. A full 32K of dynamic RAM - easily expandable to 64K. A CP/M* Disk Operating System which insures compatibility to literally hundreds of application packages presently available. And, a 12" non-glare, 24 line by 80 column screen.

You'll also get a full ASCII keyboard with an 18 key numeric pad and individual cursor control keys. Twin RS232C serial ports for fast and easy connection to a modem or printer. Dual Z80 processors which operate at 4 MHZ to insure lightning-fast program execution. And the list goes on. Feature after feature after feature.

Better yet, the SuperBrain boasts modular design to make servicing a snap. A common screwdriver is about the only service tool you'll ever need. And with the money you'll save on purchasing and maintaining the SuperBrain, you could almost buy another one. For under $3,000, it is truly one of the most remarkable microcomputers available anywhere.

Whether your application is small business, scientific or educational, the SuperBrain is certainly one of today's most exciting solutions to your microcomputer problems. Call or write us now for full details on how you can get big system performance without having to spend big bucks. So, why not see your local dealer and try one out today. Intertec systems are distributed worldwide and may be available in your area now.



2300 Broad River Rd. Columbia, SC 29210
(803) 798-9100 TWX: 810-666-2115

*Registered trademark of Digital Research, Inc.

SUPERBRAIN™

Prices reflect distribution on 8" single density diskettes. If a format is requested which requires additional diskettes, a surcharge of $8 per additional diskette will be added. A surcharge of $25 will be added for software on CSSN format DC 300XL cartridges. Media charge for 5440 disk is $100

No. 16: Take a byte.

Genuine CP/M for Apple II Available now!

All Lifeboat programs require CP/M, unless otherwise stated.
Software for most popular 8080/Z80 computer disk systems

Software with Manual / Manual Alone

☐ **CP/M* FLOPPY DISK OPERATING SYSTEM**— Digital Research's operating system configured for many popular micro-computers and disk systems:

System	Version	Price
New Apple II* SoftCard* with Z80 Microsoft BASIC version 5 with high resolution graphics	2.x	350/25 ◇
North Star Single Density	1.4	145/25 Ⓥ
North Star Double Density	1.4	145/25
North Star Single Density	2.x	170/25
North Star Double/Quad	2.x	170/25
Durango F-85	2.x	170/25
iCOM Micro-Disk 2411	1.4	145/25
iCOM 3712	1.4	170/25 Ⓥ *
iCOM 3812	1.4	170/25 *
Mils 3202/Altair 8800	1.4	145/25
Heath H8 + H17	1.4	145/25 Ⓜ
Heath H89	1.4	145/25 Ⓜ
Heath H89 by Magnolia	1.4	250/25 ◇
Heath H89 by Magnolia	2.x	300/25 ◇
Onyx C8001	2.x	300/25 ◇
Ohio Scientific C3	2.x	200/25
TRS-80 Model I	1.4	145/25 Ⓜ
TRS-80 Model II	2.x	170/25
TRS-80 Model II + Corvus	2.x	250/25
Processor Technology Helios II	1.4	145/25
Cromemco System 3	1.4	145/25
Intel MDS Single Density	1.4	145/25
Intel MDS Single Density	2.x	170/25
Micropolis Mod I	1.4	145/25 Ⓥ
Micropolis Mod II	1.4	145/25 Ⓥ

The following configurations are scheduled for release soon:

System	Version	Price
North Star Double/Quad + Corvus	2.x	250/25
North Star Horizon HD-1	2.x	250/25
Ohio Scientific C3-C	2.x	250/25
Micropolis Mod II	2.x	200/25
Mostek MDX STD Bus System	2.x	350/25 **
iCOM 3812	2.x	225/25 *
iCOM 4511/Pertec D3000	2.x	375/25 *+

*Software consists of the operating system, text editor, assembler, debugger and other utilities for file management and system maintenance. Complete set of Digital Research's documentation and additional implementation notes included. Systems marked * and ** include firmware on 2708 and 2716. Systems marked + include 5440 media charge. Systems marked Ⓜ require the special Ⓜ versions of software in this catalog. Systems marked Ⓥ have minor variants available to suit console interface of system. Call or write for full list of options. ◇ includes hardware addition to allow our standard versions of software to run under it.*

☐ **Z80 DEVELOPMENT PACKAGE**—Consists Ⓜ ② of: (1) disk file line editor, with global inter and intra-line facilities; (2) Z80 relocating assembler, Zilog/Mostek mnemonics, conditional assembly and cross reference table capabilities; (3) linking loader producing absolute Intel hex disk file .... $95/$20

☐ **ZDT**—Z80 Monitor Debugger to break and Ⓜ ② examine registers with standard Zilog/Mostek mnemonic disassembly displays. $35 when ordered with Z80 Development Package .... $50/$10

AVOCET SYSTEMS

☐ **XASM-68**—Non-macro cross-assembler with nested conditionals and full range of pseudo operations. Assembles from standard Motorola MC6800 mnemonics to Intel hex ... $200/$25

☐ **XASM-65**—As XASM-68 for MOS Technology MCS-6500 series mnemonics ...... $200/$25

☐ **XASM-48**—As XASM-68 for Intel MCS-48 and UPI-41 families .... $200/$25

☐ **XASM-18**—As XASM-68 for RCA 1802 .... $200/$25

☐ **DISTEL**—Disk based disassembler to Intel 8080 or TDL/Xitan Z80 source code, listing and cross reference files. Intel or TDL/Xitan pseudo ops optional. Runs on 8080 .... $65/$10

☐ **DISILOG**—As DISTEL to Zilog/Mostek Ⓜ ② mnemonic files .... $65/$10

Software with Manual / Manual Alone

☐ **SMAL/80** Structured Macro Assembler ③ Language—Package of powerful general purpose text macro processor and SMAL structured language compiler. SMAL is an assembler language with IF-THEN-ELSE, LOOP-REPEAT-WHILE, DO-END, BEGIN-END constructs .... $75/$15

PHOENIX SOFTWARE ASSOCIATES

☐ **PASM***—Z80 macro assembler, Intel/TDL ② mnemonics. Generates Intel hex format or re-*New* locatable code in either TDL Object Module format or PSA Relocatable Binary Module format. Supports text insertion, conditional branching within macros, recursive macro calls and parameter passing. .... $129/$25

☐ **EDIT**—Character oriented text file editor. In-② cludes macro definition capabilities. Handles *New* insertion, deletion, searching, block move, etc. for files of any length. Does not require a CRT. .... $129/$25

☐ **PLINK***—Two pass disk-to-disk linkage edi-② tor/loader which can produce re-entrant, ROMable code. Can link programs that are *New* larger than available memory for execution targeted on another machine. Full library capabilities. Input can be PSA Relocatable Binary Module, TDL Object Module or Microsoft REL files. Output can be a COM file, Intel hex file, TDL Object Module or PSA Relocatable file. .... $129/$25

☐ **BUG*** and **μBUG***—Z80 interactive machine ② level debugging tools for program development. BUG has full symbolic trace and interac-*New* tive assembly (mnemonics compatible with PASM). Dynamic breakpoints and conditional traps while tracing (even through ROM!). μBUG is a subset of BUG and is used in memory limited situations .... $129/$25

DIGITAL RESEARCH

☐ **MP/M**—Installed for single density MDS-800. Multi-processing derivative of the CP/M operating system. Manual includes CP/M2 documentation .... $300/$50

☐ **MAC**-8080—Macro assembler. Full Intel ⑤ macro definitions. Pseudo Ops include RPC, IRP, REPT, TITLE, PAGE, and MACLIB. Produces absolute hex output plus symbol table file for use by SID and ZSID (see below) $120/$15

☐ **SID**-8080—Symbolic debugger. Full trace, ⑤ pass count and breakpoint program testing. Has backtrace and histogram utilities. When used with MAC, provides full symbolic display of memory labels and equated values. $105/$15

☐ **ZSID**-Z80—Symbolic debugger with all fea-⑤ ② tures of SID .... $130/$15

☐ **TEX**—Text output formatter to create paginat-⑤ ed, page-numbered and justified copy. Output can be directed to printer or disk ... $105/$15

☐ **DESPOOL**—Utility program to permit simulta-⑤ neous printing from text files while executing other programs .... $80/$10

☐ **tiny C**—Interactive interpretive system for ⑤ teaching structured programming techniques. Manual includes full source listings. $105/$50

☐ **BDS C COMPILER**—Supports most features Ⓜ ① of language, including Structures, Arrays, Pointers, recursive function evaluation, overlays. Includes linking loader, library manager, and library containing general purpose, file I/O, and floating point functions. Lacks initializers, statics, floats and longs. Documentation includes "The C PROGRAMMING LANGUAGE" by Kernighan and Ritchie .... $145/$25

☐ **WHITESMITHS C COMPILER**—The ultimate ① ③ in systems software tools. Produces faster code than a pseudo-code Pascal with more extensive facilities. Conforms to the full UNIX* Version 7 C language, described by Kernighan and Ritchie, and makes available over 75 functions for performing I/O, string manipulation and storage allocation. Linkable to Microsoft REL files. Requires 60K CP/M ..... $630/$30

MICROSOFT

☐ **BASIC-80**—Disk Extended BASIC, ANSI ① Ⓜ compatible with long variable names, WHILE/WEND, chaining, variable length file records .... $325/$25

☐ **BASIC COMPILER**—Language compatible ① Ⓜ with BASIC-80 and 3-10 times faster execution. Produces standard Microsoft relocatable binary output. Includes MACRO-80. Also linkable to FORTRAN-80 or COBOL-80 code modules .... $350/$25

Software with Manual / Manual Alone

☐ **FORTRAN-80**—ANSI 66 (except for COM-① Ⓜ PLEX) plus many extensions. Includes relocatable object compiler, linking loader, library with manager. Also includes MACRO-80 (see below) .... $425/$25

☐ **COBOL-80**—Level 1 ANSI '74 standard ① Ⓜ COBOL plus most of Level 2. Full sequential, relative, and indexed file support with variable file names. STRING, UNSTRING, COMPUTE, VARYING/UNTIL, EXTEND, CALL, COPY, SEARCH, 3-dimensional arrays, compound and abbreviated conditions, nested IF. Powerful interactive screen-handling extensions. Includes compatible assembler, linking loader, and relocatable library manager as described under MACRO-80 .... $700/$25

☐ **MACRO-80**—8080/Z80 Macro Assembler. ① Ⓜ Intel and Zilog mnemonics supported. Relocatable linkable output. Loader, Library Manager and Cross Reference List utilities included .... $149/$15

☐ **muSIMP/muMATH**—muSIMP is a high level ① programming language suitable for symbolic *New* and semi-numerical processing. Implemented using a fast and efficient interpreter requiring only 7K bytes of machine code. muMATH is a package of programs written in muSIMP. The package performs sophisticated mathematical functions. Keeps track of up to 611 digits. Performs matrix operations on arrays: transpose, multiply, divide, inverse and other integer powers. Logarithmic, exponential, trigonometric simplification and transformation, symbolic differentiation with partial derivatives, symbolic integration of definite and indefinite integrals. Requires 40K CP/M. .... $250/$20

☐ **muLISP-79**—Microcomputer implementation ① of LISP. The interpreter resides in only 7K bytes *New* of memory yet includes 83 LISP functions. Has infinite precision integer arithmetic expressed in any radix from 2 to 36. muLISP-79 includes complete trace facility and a library of useful functions and entertaining sample programs. .... $200/$15

☐ **XMACRO-86**—8086 cross assembler. All ① Macro and utility features of MACRO-80 package. Mnemonics slightly modified from Intel ASM86. Compatibility data sheet available .... $275/$25

☐ **EDIT-80**—Very fast random access text editor ① for text with or without line numbers. Global and intra-line commands supported. File compare utility included. .... $89/$15

☐ **PASCAL/M***—Compiles enhanced Standard ⑤ Pascal to compressed efficient Pcode. Totally CP/M compatible. Random access files. Both 16 and 32-bit Integers. Runtime error recovery. Convenient STRINGs. OTHERWISE clause on CASE. Comprehensive manual (90 pp. indexed). SEGMENT provides overlay structure. INPORT, OUTPORT and untyped files for arbitrary I/O. Requires 56K CP/M. Specify 1) 8080 CP/M, 2) Z80 CP/M, or 3) Cromemco CDOS. .... $175/$20

☐ **PASCAL/Z**—Z80 native code PASCAL com-① ② piler. Produces optimized, ROMable re-entrant code. All interfacing to CP/M is through the support library. The package includes compiler, relocating assembler and linker, and source for all library modules. Variant records, strings and direct I/O are supported. Requires 56K CP/M. .... $395/$25

☐ **PASCAL/MT**—Subset of standard PASCAL. Ⓜ ⑤ Generates ROMable 8080 machine code. Symbolic debugger included. Supports interrupt procedures, CP/M file I/O and assembly language interface. Real variables can be BCD, software floating point, or AMD 9511 hardware floating point. Includes strings enumerations and record data types. Manual explains BASIC to PASCAL conversion. Requires 32K .. $250/$30

☐ **APL/V80**—Concise and powerful language for ① ② application software development. Complex programming problems are reduced to simple *New* expressions in APL. Features include up to 27K active workspace, shared variables, arrays of up to 8 dimensions, disk workspace and copy object library. The system also supports auxiliary processors for interfacing I/O ports. Requires 48K CP/M and serial APL printing terminal or CRT .... $500/$30

☐ **ALGOL-60**—Powerful block-structured lan-② guage compiler featuring economical run-time dynamic allocation of memory. Very compact (24K total RAM) system implementing almost all Algol 60 report features plus many powerful extensions including string handling direct disk address I/O etc. .... $199/$20

☐ **CBASIC-2** Disk Extended BASIC—Non-Ⓜ interactive BASIC with pseudo-code compiler and run-time interpreter. Supports full file control, chaining, integer and extended precision variables, etc. .... $120/$15

MICRO FOCUS

☐ **STANDARD CIS COBOL**—ANSI '74 COBOL ① standard compiler fully validated by U.S. Navy tests to ANSI level 1. Supports many features to level 2 including dynamic loading of COBOL modules and a full ISAM file facility. Also, program segmentation, interactive debug and powerful interactive extensions to support protected and unprotected CRT screen formatting from COBOL programs used with any dumb terminal .... $850/$50

Software with Manual / Manual Alone

☐ **FORMS 2**—CRT screen editor. Output is ① COBOL data descriptions for copying into CIS COBOL programs. Automatically creates a query and update program of indexed files using CRT protected and unprotected screen formats. No programming experience needed. Output program directly compiled by STANDARD CIS COBOL .... $200/$20

EIDOS SYSTEMS

☐ **KISS**—Keyed Index Sequential Search. Offers ① complete Multi-Keyed Index Sequential and Direct Access file management. Includes built-in utility functions for 16 or 32 bit arithmetic, string/integer conversion and string compare. Delivered as a relocatable linkable module in Microsoft format for use with FORTRAN-80 or COBOL-80, etc. .... $335/$23

☐ **KBASIC**—Microsoft Disk Extended BASIC ① version 4.51 integrated by implementation of nine additional commands in language. Package includes KISS. REL as described above, and a sample mail list program. .... $585/$45 To licensed users of Microsoft BASIC-80 (MBASIC) .... $435/$45

☐ **XYBASIC** Interactive Process Control BASIC—Full disk BASIC features plus unique commands to handle byte rotate and shift and to test and set bits. Available in several versions:

Integer ROM squared	$350/$25
Integer CP/M	$350/$25
Extended ROM squared	$450/$25
Extended CP/M	$450/$25
Extended Disk CP/M	$550/$25
Integer CP/M Run Time Compiler	$350/$25
Extended CP/M Run Time Compiler	$450/$25

☐ **RECLAIM**—A utility to validate media under CP/M. Program tests a diskette or hard disk surface for errors, reserving the imperfections in invisible files, and permitting continued usage of the remainder. Essential for any hard disk. Requires CP/M version 2. ...... $80/$5

☐ **BASIC UTILITY DISK**—Consists of: (1) Ⓜ CRUNCH-14—Compacting utility to reduce the size and increase the speed of programs in Microsoft BASIC 4.51, BASIC-80 and TRS-80 BASIC. (2) DPFUN—Double precision subroutines for computing nineteen transcendental functions including square root, natural log, log base 10, sine, arc sine, hyperbolic sine, hyperbolic arc sine, etc. Furnished in source on diskette and documentation .... $50/$35

☐ **STRING/80**—Character string handling plus routines for direct CP/M BDOS calls from FORTRAN and other compatible Microsoft languages. The utility library contains routines that enable programs to chain to a COM file, retrieve command line parameters and search file directories with full wild card facilities. Supplied as linkable modules in Microsoft format. $95/$20

☐ **STRING/80** source code available separately— $295/NA

☐ **THE STRING BIT**—FORTRAN character Ⓜ string handling. Routines to find, fill, pack, move, separate, concatenate and compare character strings. This package completely eliminates the problems associated with character string handling in FORTRAN. Supplied with source .... $65/$15

☐ **VSORT**—Versatile sort/merge system for fixed Ⓜ length records with fixed or variable length fields. VSORT can be used as a stand-alone package or loaded and called as a subroutine from CBASIC-2. When used as a subroutine, VSORT maximizes the use of buffer space by saving the TPA on disk and restoring it on completion of sorting. Records may be up to 255 bytes long with a maximum of 5 fields. Upper/lower case translation and numeric fields supported. .... $175/$20

☐ **CPM/374X**—Has full range of functions to create or re-name an IBM 3741 volume, display directory information and edit the data set contents. Provides full file transfer facilities between 3741 volume data sets and CP/M files .... $195/$10

Coming Soon

CPAids*

☐ **MASTER TAX**—Professional tax preparation ① † program. Prepares schedules A, B, C, D, E, F, G, R/RP, SE, TC, ES and forms 2106, 2119, 2210, 3468, 3903, 2441, 4625, 4726, 4797, 4972, 5695 and 6521. Printing can be on readily available, pre-printed continuous forms, on overlays, or on computer generated, IRS approved forms. Maintains client history files and is interactive with CPAids GENERAL LEDGER II (see below) .... $995/$30

☐ **STANDARD TAX**—As above for schedules A, † B, C, D, E, G, R/RP, SE, TC and forms 2106 and 2441. Also, does not maintain client history files .... $495/$30

☐ **GENERAL LEDGER II**—Designed for CPA's. † Stores complete 12 month detailed history of transactions. Generates financial statements, depreciation, loan amortizations, journals, trial balances, statements of changes in financial position, and compilation letters. Includes payroll system with automatic posting to general ledger. Prints payroll register, W2's and payroll checks. .... $450/$30

Lifeboat Associates, 1651 Third Avenue, N.Y., N.Y. 10028 **(212) 860-0300** Telex: 220501
Neu in der Schweiz Lifeboat Associates GmbH, Aegeristr. 35, 6340 Baar **Telefon 042/31 2931**

Software with Manual / Manual Alone

New

☐ **T/MAKER**—Powerful new tool for preparing management reports with tabular data. Makes financial modeling projects easy. Do you want a weekly profitability report? Set up the table and compute. Just change the sales figures for next week and compute. You have a new report! T/MAKER includes a full screen editor for setting up tables which pages left, right, up and down. Compute includes standard arithmetic, percents, exponents, common transcendental functions, averages, maxima, minima, projections, etc. Requires 48K CP/M and CBASIC-2 .... $275/$25

☐ **BSTAM**—Utility to link one computer to another Ⓜ also equipped with BSTAM. Allows file transfers at full data speed (no conversion to hex), with CRC block control check for very reliable error detection and automatic retry. We use it! It's great! Full wildcard expansion to send *.COM, etc. 9600 baud with wire. 300 baud with phone connection. **Both** ends need one. Standard and Ⓜ versions can talk to one another. .$150/$10

☐ **WHATSIT?***—Interactive data-base system using associative tags to retrieve information by subject. Hashing and random access used for fast response. Requires CBASIC-2 .$175/$25

☐ **SELECTOR III-C2**—Data Base Processor to † create and maintain multi-key data bases. Ⓜ Prints formatted sorted reports with numerical summaries or mailing labels. Comes with sample applications, including Sales Activity, Inventory, Payables, Receivables, Check Register, and Client/Patient Appointments, etc. Requires CBASIC-2. Supplied in source .... $295/$20

☐ **GLECTOR**—General Ledger option to SELECTOR III-C2. Interactive system provides for customized COA. Unique chart of transaction types insure proper double entry bookkeeping. Generates balance sheets, P&L statements and journals. Two year record allows for statement of changes in financial position report. Supplied in source. Requires SELECTOR III-C2, CBASIC-2 and 56K system. .... $350/$25

☐ **CBS**—Configurable Business System is a comprehensive set of programs for defining custom data files and application systems without using a programming language such as BASIC, FORTRAN, etc. Multiple key fields for each data file are supported. Set-up program customizes system to user's CRT and printer. Provides fast and easy interactive data entry and retrieval **with transaction processing**. Report generator program does complex calculations with stored and derived data, record selection with multiple criteria, and custom formats. Sample inventory and mailing list systems included. **No support language required** .... $295/$40

MICRO DATA BASE SYSTEMS

☐ **HDBS**—Hierarchical Data Base System. CODASYL oriented with FILEs, SETs, RECORDs and ITEMs which are all user defined. ADD, DELETE, UPDATE, SEARCH, and TRAVERSE commands supported. SET ordering is sorted, FIFO, LIFO, next or prior. One to many set relationship supported. Read/write protection at the FILE level. Supports FILEs which extend over multiple floppy or hard disk devices.

☐ **MDBS**—Micro Data Base System. Full network data base with all features of HDBS plus multi-level read/write protection for FILE, SET, RECORD and ITEM. Explicit representation of one to one, one to many, many to many, and many to one SET relationships. Supports multiple owner and multiple record types within SETs. HDBS files are fully compatible. *New Features* *New Manual*

☐ **HDBS-Z80** version .... $250/$40**

☐ **MDBS-Z80** version .... $750/$40**
8080 version available at $75 extra.

When ordering, specify one of the language interfaces listed below. Additional language interfaces available at time of purchase for $100 or $125 if purchased later.

**The single manual covering HDBS and MDBS when purchased alone comes without specific language interface manual. Manuals are available for the following Microsoft languages:

1) MBASIC 4.51, 2) BASIC-80 5.0, 3) Compiled BASIC or FORTRAN-80, 4) COBOL-80, 5) MACRO-80. .... $NA/$10

MICROPRO

☐ **SUPER-SORT I**—Sort, merge, extract utility as Ⓛ absolute executable program or linkable module in Microsoft format. Sorts fixed or variable records with data in binary, BCD, Packed Decimal, EBCDIC, ASCII, floating & fixed point, exponential, field justified, etc. Even variable number of fields per record! .... $225/$25

☐ **SUPER-SORT II**—Above available as abso- Ⓛ lute program only .... $175/$25

☐ **SUPER-SORT III**—As II without SELECT/ Ⓛ EXCLUDE .... $125/$25

☐ **DATASTAR**—Professional forms control entry Ⓛ and display system for key-to-disk data capture. Menu driven with built-in learning aids. Input field verification by length, mask, attribute (i.e. upper case, lower case, numeric, auto-dup, etc.). Built-in arithmetic capabilities using keyed data, constant and derived values. Visual feedback for ease of forms design. Files compatible with CP/M-MP/M supported languages. Requires 32K CP/M .... $350/$35

Software with Manual / Manual Alone

☐ **WORD-STAR**—Menu driven visual word pro- Ⓛ cessing system for use with standard terminals. Text formatting performed on screen. Facilities for text paginate, page number, justify, center and underscore. User can print one document while simultaneously editing a second. Edit facilities include global search and replace, Read/Write to other text files, block move, etc. Requires CRT terminal with addressable cursor positioning .... $445/$40

☐ **WORD-STAR-MAIL-MERGE**—As above with Ⓛ option for production mailing of personalized documents with mail lists from DATASTAR or NAD .... $575/$40

☐ **WORD-STAR Customization Notes**—For sophisticated users who do not have one of the many standard terminal or printer configurations in the distribution version of WORD-STAR .... $NA/$95

☐ **WORD-MASTER** Text Editor—In one mode Ⓛ has superset of CP/M's ED commands including global searching and replacing, forwards and backwards in file in video mode, provides full screen editor for users with serial addressable-cursor terminal .... $145/$25

☐ **TEXTWRITER III**—Text formatter to justify and Ⓜ paginate letters and other documents. Special features include insertion of text during execution from other disk files or console, permitting recipe documents to be created from linked fragments on other files. Has facilities for sorted index, table of contents and footnote insertions. Ideal for contracts, manuals, etc. Now compatible with Electric Pencil* and Word-Star prepared files .... $125/$20

New lower prices for application Software

PEACHTREE SOFTWARE

☐ General accounting software for small busi- Ⓛ nesses. Each product can be used alone or with † automatic posting to the general ledger. Supplied in source for Microsoft BASIC 4.51.

GENERAL LEDGER	$530/$40
ACCOUNTS PAYABLE	$530/$40
ACCOUNTS RECEIVABLE	$530/$40
PAYROLL	$530/$40
INVENTORY	$660/$40
ALSO:	
MAILING ADDRESS	$530/$40
PROPERTY MANAGEMENT	$925/$40

GRAHAM-DORIAN SOFTWARE SYSTEMS

☐ Comprehensive accounting software written in Ⓛ CBASIC-2 and supplied in source code. Each Ⓜ software package can be used as a stand-alone † system or integrated with the General Ledger for automatic posting to ledger accounts. Requires CBASIC-2.

GENERAL LEDGER	$805/$40
ACCOUNTS PAYABLE	$805/$40
ACCOUNTS RECEIVABLE	$805/$40
INVENTORY SYSTEM	$555/$40
JOB COSTING	$805/$40
APARTMENT MANAGEMENT	$805/$40
CASH REGISTER	$805/$40

☐ **POSTMASTER**—A comprehensive package Ⓜ for mail list maintenance that is completely menu driven. Features include keyed record extraction and label production. A form letter program is included which provides neat letters on single sheet or continuous forms. Includes NAD file translator. Requires CBASIC-2 .... $150/$20

STRUCTURED SYSTEMS GROUP

☐ Complete interactive accounting software for † business. Each product can be used standalone or with automatic posting to the general ledger. Each product is thoroughly tested and very well documented. Each product requires CBASIC-2.

GENERAL LEDGER	$820/$40
ACCOUNTS RECEIVABLE	$820/$40
ACCOUNTS PAYABLE	$820/$40
PAYROLL	$820/$40
INVENTORY CONTROL	$820/$40

NEW! NEWSLETTER FROM LIFEBOAT

LIFELINES

- Latest Version Numbers List of Software
- Update on CP/M Users Group
- The Great ZOSO Speaks Out from Behind the Scenes

$18 ppd. for 12 issues (U.S., Canada, Mexico). Elsewhere **$40.**
Send Check to "Lifelines," 1651 Third Avenue, New York, N.Y. 10028 or use your *VISA* or *Mastercharge*—call (212) 722-1700

Software with Manual / Manual Alone

☐ **ANALYST**—Customized data entry and report- † ing system. User specifies up to 75 data items per record. Interactive data entry, retrieval, and update facility makes information management easy. Sophisticated report generator provides customized reports using selected records with multiple level breakpoints for summarization. Requires a disk sort utility such as QSORT, SUPER-SORT or VSORT and CBASIC-2 .... $250/$15

☐ **LETTERIGHT**—Program to create, edit and type letters or other documents. Has facilities to enter, display, delete and move text, with good video screen presentation. Designed to integrate with NAD for form letter mailings. Requires CBASIC-2 .... $200/$25

☐ **NAD** Name and Address selection system—Interactive mail list creation and maintenance program with output as full reports with reference data or restricted information for mail labels. Transfer system for extraction and transfer of selected records to create new files. Requires CBASIC-2 .... $100/$20

☐ **QSORT**—Fast sort/merge program for files with fixed record length, variable field length information. Up to five ascending or descending keys. Full back-up of input files created .... $100/$20

★ ★ ★ CONDIMENTS ★ ★ ★

☐ **HEAD CLEANING DISKETTE**—Cleans the drive Read/Write head in 30 seconds. Diskette absorbs loose oxide particles, fingerprints, and other foreign particles that might hinder the performance of the drive head. Lasts at least 3 months with daily use. Specify 5" or 8".
Single sided .... $20 each/$55 for 3
Double sided .... $25 each/$65 for 3

☐ **FLIPPY DISK KIT**—Template and instructions to modify single sided 5¼" diskettes for use of second side in single sided drives $12.50

☐ **FLOPPY SAVER**—Protection for center holes for 5" and 8" floppy disks. Only 1 needed per diskette. Kit contains centering post, pressure tool and tough 7 mil mylar reinforcing rings for 25 diskettes.

5", Kit	$14.95
5", Rings only	$7.95
8", Kit	$16.95
8", Rings only	$8.95

☐ **PASCAL USER MANUAL AND REPORT**—By Jensen and Wirth. The standard textbook on the language. Recommended for use by Pascal/Z, Pascal/M and Pascal/MT users $12

☐ **THE C PROGRAMMING LANGUAGE**—By Kernighan and Ritchie. The standard textbook on the language. Recommended for use by BDS C, tiny C, and Whitesmiths C users .. $12

☐ **STRUCTURED MICROPROCESSOR PROGRAMMING**—By the authors of SMAL/80. Covers structured programming, the 8080/8085 instruction set and the SMAL/80 language $20

☐ **ACCOUNTS PAYABLE & ACCOUNTS RECEIVABLE—CBASIC**—By Osborne/McGraw-Hill $20

☐ **GENERAL LEDGER—CBASIC**—By Osborne/McGraw-Hill $20

☐ **PAYROLL WITH COST ACCOUNTING—CBASIC**—by Osborne/McGraw-Hill $20

☐ **LIFEBOAT DISK COPYING SERVICE**—Transfer data or programs from one media format to another at a moderate cost . . from $25

★ ★ ★ Hearty Appetite. ★ ★ ★

*CP/M and MP/M are trademarks of Digital Research.
Z80 is a trademark of Zilog, Inc.
UNIX is a trademark of Bell Laboratories.
WHATSIT? is a trademark of Computer Headware.
Electric Pencil is a trademark of Michael Shrayer Software.
TRS-80 is a trademark of Tandy Corp.
Pascal/M is a trademark of Sorcim.
SoftCard is a trademark of Microsoft.
Apple is a trademark of Apple Computer.
PASM, PLINK, BUG and μBUG are trademarks of Phoenix Software Associates Ltd.
CPAids is a trademark of Computer Tax Service, Inc.

† Recommended system configuration consists of 48K CP/M, 2 full size disk drives, 24 x 80 CRT and 132 column printer.

● Modified version available for use with CP/M as implemented on Heath and TRS-80 Model I computers.

Ⓛ User license agreement for this product must be signed and returned to Lifeboat Associates before shipment may be made.

Ⓘ This product Includes/eXcludes the language Ⓧ manual recommended in Condiments.

Ⓢ Serial number of CP/M system must be supplied with orders.

Ⓩ Requires Z80 CPU.

Ordering Information

MEDIA FORMAT ORDERING CODES
When ordering, please specify format code.

LIFEBOAT ASSOCIATES MEDIA FORMATS LIST
Diskette, cartridge disk and cartridge tape format codes to be specified when ordering software for listed computer or disk systems. All software products have specific requirements in terms of hardware or software support, such as MPU type, memory size, support operating system or language.

Computer system	Format Code	Computer system	Format Code	Computer system	Format Code
Altair 8800 Disk	See MITS 3200	IMS 5000	RA	Research Machines 8"	A1
Altos	A1*	IMS 8000	A1*	Research Machines 5¼"	RH
Apple + SoftCard 13 Sector	RG	IMSAI VDP-40	R4**	REX	Q3
Apple + SoftCard 16 Sector	RR	IMSAI VDP-42	R4**	Sanco 7000 5¼"	RO
BASF System 7100	RD	IMSAI VDP-44	R5**	SD Systems 8"	A1*
Blackhawk Single Density	Q3	IMSAI VDP-80	A1**	SD Systems 5¼"	R3
Blackhawk Micropolis Mod II	Q2	Intecolor	See ISC Intecolor	Sorcerer	See Exidy Sorcerer
CDS Versatile 3B	O1	Intel MDS Single Density	A1	Spacebyte	A1
CDS Versatile 4	Q2	Intertec SuperBrain DOS 0.1	R7	SuperBrain	See Intertec
COMPAL-80	Q2	Intertec SuperBrain DOS 0.5-2.X	RJ	Tarbell	A1*
Cromemco System 3	A1*	Intertec SuperBrain DOS 3.X	RK	TEI 5¼"	R3
Cromemco Z2D	R6	ISC Intecolor 8063/8360/8963	A1	TEI 8"	A1*
CSSN BACKUP (tape)	T1 #	Kontron PSI-80	RF	Thinkertoys	See Morrow Discus
Delta	A1*	Meca 5¼"	P6	TRS-80 Model I 5¼"	R2
Digi-Log Microterm II	RD	Micromation (Except TRS-80 below)	A1*	TRS-80 Model I + FEC Freedom	RN
Digital Microsystems	A1*	Micropolis Mod I	O1	TRS-80 Model I + Micromation	A4*
Discus	See Morrow Discus	Micropolis Mod II	Q2	TRS-80 Model I + Omikron 5¼"	RM
Durango F-85	RL	MITS 3200/3202	B1	TRS-80 Model I + Omikron 8"	A1
Dynabyte DB8/2	R1	Morrow Discus	A1*	TRS-80 Model I + Shuffleboard 8"	A1
Dynabyte DB8/4	A1*	Mostek	A1	TRS-80 Model II	A1*
Exidy Sorcerer + Lifeboat CP/M	Q2	MSD 5¼"	RC	VDP-40/42/44/80	See IMSAI
Exidy Sorcerer + Exidy CP/M	Q4	North Star Single Density	P1	Vector MZ	Q2
Heath H8 + H17/H27	P4	North Star Double/Quad	P2	Versatile	See CDS Versatile
Heath H89 + Lifeboat CP/M	P4	Nylac Single Density	Q3	Vista V80 5¼" Single Density	P5
Heath H89 + Magnolia CP/M	P7	Nylac Micropolis Mod. II	Q2	Vista V200 5¼" Double Density	P6
Helios II	See Processor Technology	Ohio Scientific C3	A3	Zenith Z89 + Lifeboat CP/M	P4
Horizon	See North Star	Onyx C8001	T2 #	Zenith Z89 + Magnolia CP/M	P7
iCOM 2411 Micro Floppy	R3	Pertec PCC 2000	A1*		
iCOM 3712	A1	Processor Technology Helios II	B2		
iCOM3812	A1*	Quay 500	RO		
iCOM 4511 5440 Cartridge CP/M 1.4	D1 #	Quay 520	RP		
iCOM 4511 5440 Cartridge CP/M 2.2	D2#	RAIR Single Density	R9		
		RAIR Double Density	RE		

Prices F.O.B. New York. Shipping, handling and C.O.D. charges extra.

Manual cost applicable against price of subsequent software purchase.

The sale of each proprietary software package conveys a license for use on one system only.

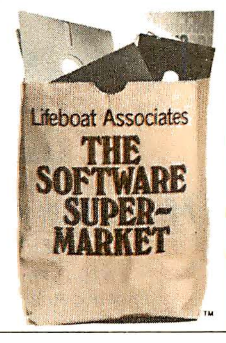
VISA master charge

* Single-Side Single-Density disks are supplied for use with Double-Density and Double-Side 8" soft sector format systems.

** IMSAI formats are single density with directory offset of zero.

\# A media surcharge of $25 for orders on tape formats T1 and T2 and of $100 for orders on disk formats D1 and D2 will be added.

The list of available formats is subject to change without notice. In case of uncertainty, call to confirm the format code for any particular equipment.



™ *The Software Supermarket is a trademark of Lifeboat Associates*

Address	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	
000	00	00	00	00	00	00	00	00	04	02	7F	02	04	00	00	00	→
010	00	00	00	00	00	00	08	08	1C	2A	2A	2A	1C	08	08	00	⌽
020	00	00	00	00	00	00	00	3E	08	08	08	08	00	00	00	00	⊥
030	00	00	00	00	00	00	22	22	22	3E	22	22	1C	00	00	00	∩
040	00	00	00	00	00	00	1C	10	10	10	10	10	10	10	10	00	L
050	00	00	00	00	00	00	0C	10	20	3C	20	10	0C	00	00	00	∈
060	00	00	00	00	00	00	08	08	08	1C	2A	49	7F	08	08	00	⍒
070	00	00	00	00	00	00	00	00	08	14	22	41	7F	00	00	00	∇
080	00	00	00	00	00	00	08	08	7F	49	2A	1C	08	08	08	00	⍋
090	00	00	00	00	00	00	04	08	08	08	08	10	00	00	00	00	⍳
0A0	00	00	00	00	00	00	00	00	18	24	24	18	00	00	00	00	∘
0B0	00	00	00	00	00	00	7F	41	41	41	41	49	49	49	7F	00	⍞
0C0	00	00	00	00	00	00	7F	41	41	41	41	41	41	41	7F	00	⎕
0D0	00	00	00	00	00	00	00	3E	08	08	08	3E	00	00	00	00	⌶
0E0	00	00	00	00	00	00	00	08	08	08	08	3E	00	00	00	00	⊤
0F0	00	00	00	00	00	00	00	1C	22	41	49	41	22	1C	00	00	⊙
100	00	00	00	00	00	00	00	00	10	20	7F	20	10	00	00	00	←
110	00	00	00	00	00	00	00	00	22	14	08	14	22	00	00	00	×
120	00	00	00	40	20	10	1E	11	11	0E	00	00	00	00	00	00	⍴
130	00	00	00	00	00	00	10	10	10	10	10	10	10	10	1C	00	⌈
140	00	00	00	00	00	00	00	01	1E	26	2A	32	3C	40	00	00	⍉
150	00	00	00	00	00	00	08	1C	2A	08	08	08	08	08	08	00	↓
160	00	00	00	00	00	00	00	1C	22	35	49	6B	2A	1C	00	00	⍟
170	00	00	00	00	00	00	00	08	00	00	7F	00	00	08	00	00	÷
180	00	00	00	00	00	00	00	00	08	14	22	41	00	00	00	00	∨
190	00	00	00	00	00	00	08	08	08	08	08	08	2A	1C	08	00	↑
1A0	00	00	00	00	00	00	00	00	00	41	22	14	08	00	00	00	∧
1B0	00	00	00	00	00	00	7F	41	49	41	7F	41	49	41	7F	00	⌹
1C0	00	00	00	00	00	00	3E	00	04	08	10	20	10	08	04	00	≤
1D0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	7F	00	-
1E0	00	00	00	00	00	00	3E	00	10	08	04	02	04	08	10	00	≥
1F0	00	00	00	00	00	00	00	40	20	7F	08	7F	02	01	00	00	≠

Table 1: *Data that must be programmed into the 2708 erasable programmable read-only memory (EPROM) device. This data tells the video display how to form the APL characters from a dot matrix. To the left is the address of the data, in the center*

Circle 81 on inquiry card.

200	00	00	00	00	00	00	08	1C	2A	2A	1C	08	7F	00	00	00	Φ
210	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
220	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
230	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
240	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
250	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
260	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
270	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
280	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
290	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
2A0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
2B0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
2C0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
2D0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
2E0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
2F0	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
300	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
310	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
320	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
330	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	00	
340	00	00	00	00	00	00	4A	2E	20	57	2E	20	00	00	00	00	
350	00	00	00	00	00	00	4C	61	6E	67	6E	65	72	20	00	00	
360	00	00	00	00	00	00	57	42	32	4F	53	5A	2F	36	20	00	
370	00	00	00	00	00	00	33	2F	34	2F	37	38	00	00	00	00	
380	00	00	00	00	00	00	42	24	18	18	24	42	00	00	00	00	x
390	00	00	00	3C	02	02	3E	42	42	42	42	42	00	00	00	00	y
3A0	00	00	00	00	00	00	7E	20	10	08	04	7E	00	00	00	00	z
3B0	00	00	00	00	00	00	00	00	00	41	6A	15	08	00	00	00	
3C0	00	00	00	00	00	00	08	08	08	08	00	08	08	08	08	00	¦
3D0	00	00	00	00	00	00	00	00	08	54	2B	41	00	00	00	00	
3E0	00	00	00	00	00	00	00	00	44	2A	11	00	00	00	00	00	~
3F0	00	00	00	00	00	00	7F	7F	7F	7F	7F	7F	7F	7F	7F	00	■

is the data in hexadecimal form, and to the right is the character formed by the data in that row.

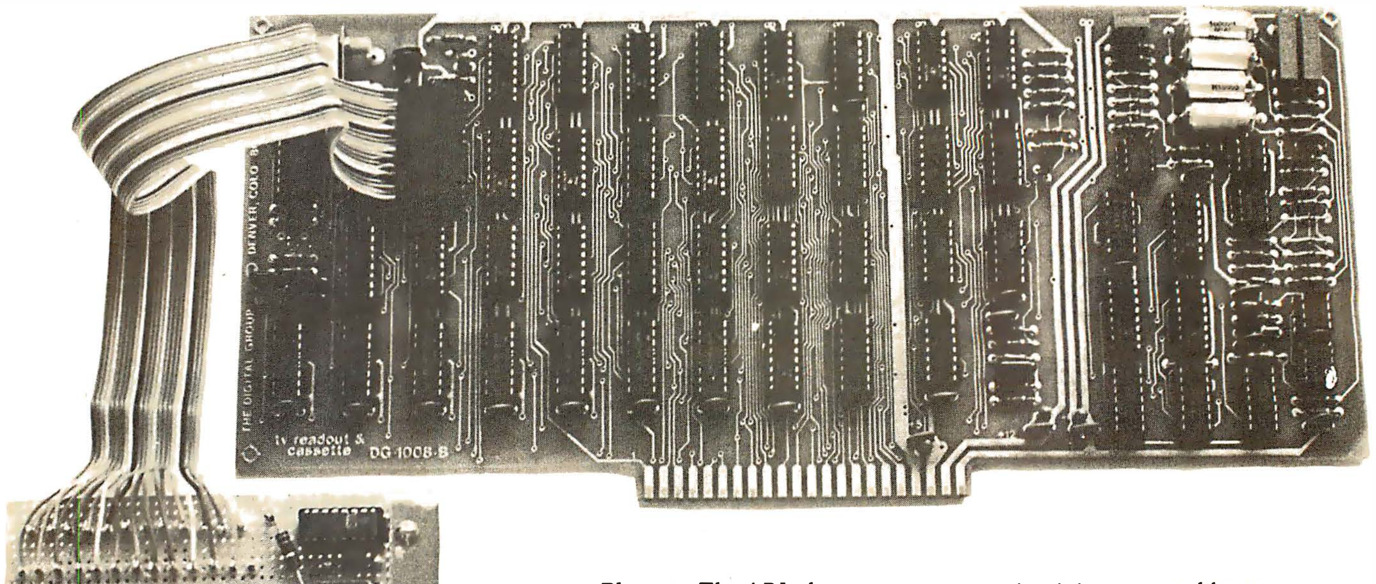


Photo 3: *The APL character-generator circuit is connected by a ribbon cable to the socket formerly occupied by the MCM6571 part on the video display board. Use of sockets enables you to unplug the APL character-generator circuit and plug the MCM6571 back into the video display board if you need to reactivate the Greek characters.*

Hexadecimal Code	Old Character	New Character	Hexadecimal Code	Old Character	New Character
00	α	→	10	ρ	←
01	β	⌽	11	σ	×
02	γ	⊥	12	τ	ρ
03	δ	⍝	13	υ	⌈
04	ε	⌊	14	φ	⍉
05	ζ	∊	15	χ	↓
06	η	⍒	16	ψ	⊗
07	θ	∇	17	ω	÷
08	ι	⍋	18	Ω	∨
09	κ	⍳	19	√	↑
0A	λ	∘	1A	→	∧
0B	μ	⍞	1B	←	⌹
0C	ν	⎕	1C	↑	≤
0D	ξ	⌶	1D	÷	-
0E	ο	⊤	1E	Σ	≥
0F	π	⊙	1F	≈	≠
			60	`	⍕
			7B	{	⍲
			7D	}	⍱

Table 2: *Table of character substitution to swap the APL characters for the Greek alphabet and other seldom-used characters in the MCM6571 character-generator chip.*

Construction of a Fourth-Generation Video Terminal:

Part 2

Theron Wierenga
POB 2007
Holland MI 49423

Last month in Part 1, I presented the first part of a complete plan for building a versatile, microprocessor-controlled video terminal. Now we'll look at the rest of the construction details.

We stopped at the point of troubleshooting the 8085 microprocessor and related circuitry. If your tests with oscilloscope and frequency counter show that everything built so far checks out properly, you can proceed with the remainder of the construction.

Getting the Debug Monitor Operating

The next step is to install the four 2114 memory circuits, IC19 (the 74LS138 that decodes the 2114s), IC13 (the 7401 that is used with the 74LS138 decoder), and IC4 and IC5 (the two 8212s that are connected back-to-back to buffer the 2114s). The 2716 must be programmed again, this time with the entire software package that is given in listing 2.

The numbering sequence of figures, listings, and photos is continued from Part 1 of this article.

Before continuing, let me define some terms that are frequently used in the next section. Figure 4 on page 128 is a block diagram relating a number of these terms.

- Host computer: the computer to which your completed video terminal will be connected. It will operate completely independently of the terminal circuitry. Communications between the host computer and the video terminal will be via a serial interface driven by UARTs.
- 8085 microprocessor: the computer that will control the internal operation of the video terminal.
- Checkout terminal: any standard computer terminal with a current-loop interface that will be used to debug your video terminal's hardware and software.
- Temporary interface: a simple circuit that must be built to temporarily connect your video terminal to the checkout terminal.
- Terminal control software: the software that directs the 8085 in the procedure of controlling the terminal. It operates the display and takes care of incoming characters and scrolling. This software resides in the 2716 programmable read-only memory.
- System monitor: a separate operating system that resides within the terminal control software. When this monitor is used, the 8085 microprocessor "abandons" the video terminal circuitry, and then behaves as a separate computer for the checkout terminal. The monitor allows the user to load and display memory locations, run simple programs, and fill and move blocks of data in the memory. The data transfer lines to the host computer are not connected when using the monitor.

Activating the Monitor

In normal operation the 8085 operates as a dedicated microprocessor. This means that the microprocessor's total job is to operate the display and process incoming characters. The 2716 programmable read-only memory can hold 2048 bytes of program code. Only about 1500 bytes are needed for the terminal control software, so a portion of the

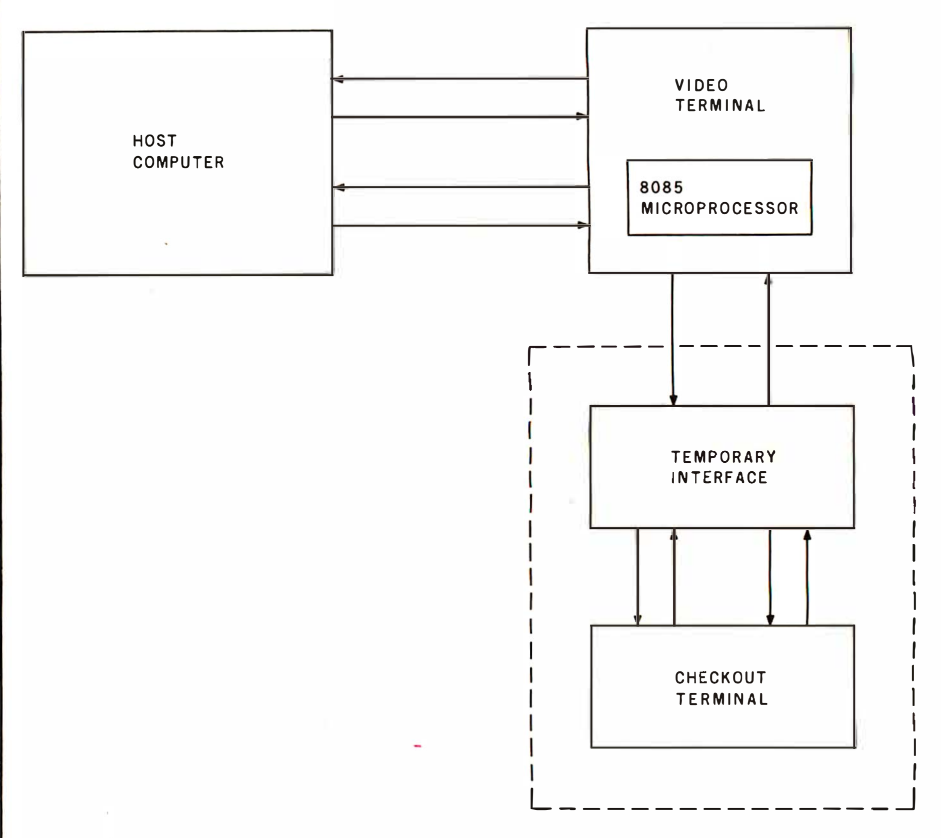


Figure 4: *Block diagram of the connection of the video terminal to the host computer. Also shown are the temporary connections to the checkout terminal, used for debugging the project.*

additional memory has been filled with a completely separate operating system which is termed the *system monitor*. By causing the 8085 microprocessor to execute a TRAP interrupt, a jump is made to the section of memory wherein the system monitor resides. In this mode the 8085 microprocessor and its associated circuitry cease to control the video terminal circuitry. The 8085 now behaves as a simple computer with a system monitor. Another terminal, the checkout terminal, is necessary to communicate with the system monitor; the temporary interface is also necessary to connect to the checkout terminal.

Construct this interface for temporary use by breadboarding. A schematic diagram was shown in figure 3, part 1. Any general-purpose computer terminal with a 20 mA current-loop interface can now be connected to your video-terminal board. The 8085 microprocessor will be acting as a computer for the checkout terminal. Be sure that the data rate is the same for both devices. If your checkout terminal runs at 110 bps, you will have to temporarily connect a 7040 Hz square wave into pins 9 and 25 of the 8251 (IC7), since this frequency is not available on the video-terminal board.

When all connections to the temporary interface are made, open the TRAP switch for a moment. The 8085 microprocessor should send a carriage return, line feed, and question mark to your checkout terminal. Next, type a letter D, and the terminal should perform a carriage return and line feed. Now type in four 0s, and it should again perform the carriage return and line feed. Lastly, type in "003F" and the checkout terminal should print out four lines of memory contents. If you get to this point, congratulate yourself, take a break, have a glass of wine, and show the family you're not as crazy as they thought you were to start this project.

If you were able to get the first test program to send out "U" characters,

Text continued on page 152:

A Small-Systems Breakthrough!

UDS Line-Powered Data Modems

- 0-300 bps full-duplex (Model 103 LP) or 0-1200 bps half-duplex (Model 202 LP) over ordinary two-wire telephone circuits
- No AC power required
- Fits under your telephone handset
- Easy hook-up
- Simplified controls — talk/data only
- Direct connect to dial-up network
- Better data integrity than acoustic couplers at the same (or lower) price

Patent Applied For

Your telephone, combined with a UDS 103 LP or 202 LP modem, can put your computer system in contact with the rest of the DP world.

Make three easy snap-in cable connections and either of these FCC-approved devices is ready to go on-line. A front-panel rocker switch lets you go from voice to data and back again whenever you wish. Either the 103 or the 202 fits comfortably under your telephone — you'll hardly know the modem is there.

The UDS units are compatible with Bell 103- and 202-series modems.

SPECIFICATIONS

OPERATION — full-duplex (Model 103 LP) or half-duplex (Model 202 LP) on two-wire dial-up telephone circuits.
DATA RATE — 0-300 bps (Model 103 LP) or 0 to 1200 bps (Model 202 LP).
DIGITAL INTERFACE — RS-232C on both models; TTY current loop on Model 103 LP.
CONTROLS AND INDICATORS — Data/Talk switch; data ON light emitting diode.

DISTRICT OFFICES: **Summit, N J,** 201/522-0025 • **Blue Bell, PA,** 215/643-2336 • **Atlanta,** 404/952-3463 • **Chicago,** 312/441-7450 • **Dallas,** 214/385-0426 • **Santa Ana,** 714/972-4619 • **Sunnyvale,** 408/738-0433 • **Boston,** 617/875-8868

"Confidence in Communications"

Universal Data Systems

5000 Bradford Drive • Huntsville, AL 35805 • Phone 205/837-8100



Member IDCMA

Created by Dayner/Hall, Inc., Winter Park, Florida

Listing 2: *The main video-terminal-control routine. Appended at the end is the system monitor used in the checkout procedure. This code is stored in the 2716 read-only memory. The program was modified by the author from the original routine provided by Intel Corporation.*

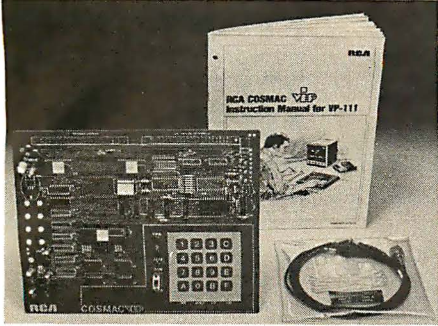
```
 C CRTLF
1
 8080 MACRO ASSEMBLER, VER 2.0   ERRORS = 0 PAGE 1

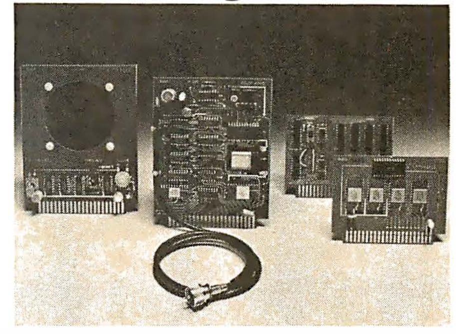

                    ;****************************************
                    ;****          CRT DRIVER            ****
                    ;****************************************
                    ;**** AS PER 'INTEL PERIPHERAL       ****
                    ;**** DESIGN HANDBOOK', PAGE 2-164.  ****
                    ;**** COPYRIGHT INTEL CORP. - 1978   ****
                    ;****************************************
                    ;**** MODIFIED BY THERON WIERENGA    ****
                    ;**** JANUARY 10, 1979               ****
                    ;****************************************
 0001               CNCTL  EQU  0001H
 0000               CNIN   EQU  0000H
 0000               CNOUT  EQU  0000H       ;8251 OUPUT DATA ADD
 0061               KCOM   EQU  061H        ;8279 COMMAND ADD
 0060               KDAT   EQU  060H        ;8279 DATA ADDRESS
 0051               CRCOM  EQU  051H        ;8275 COMMAND ADD
 0050               CRDAT  EQU  050H        ;8275 DATA ADDRESS
 0044               PC2SA  EQU  044H        ;8257 CH 2 START ADD
 0045               PC2TC  EQU  045H        ;8257 CH 2 TERM COUNT
 0046               PC3SA  EQU  046H        ;8257 CH 3 START ADD
 0047               PC3TC  EQU  047H        ;8257 CH 3 TERM COUNT
 0000               MDC57  EQU  0           ;8257 MODE CLEAR
 0084               MDS57  EQU  084H        ;8257 MODE SET
 0048               PMD57  EQU  048H        ;8257 MODE SET
                    ;**************************************************
                    ; COLD START
                    ;
 0000   C34000             JMP  CRTGO       ;JUMP TO START OF PROGRAM
 0024                      ORG  0024H
 0024   C3E905             JMP  SSS2        ;TRAP TO MONITOR
 0040                      ORG  0040H
 0040   31FF87      CRTGO: LXI  SP,87FFH    ;LOAD STACK POINTER
                    ;
                    ; CLEAR MEMORY
                    ;
 0043   21FF7F             LXI  H,7FFFH     ;LOAD SCREEN START-1
 0046   23          ALPHA: INX  H           ;INCREMENT ADDRESS
 0047   3620               MVI  M,020H      ;LOAD A SPACE
 0049   7D                 MOV  A,L         ;CHECK IF L=CF
 004A   FECF               CPI  0CFH
 004C   C24600             JNZ  ALPHA       ;IF NOT LOOP
 004F   7C                 MOV  A,H         ;CHECK IF H=87
 0050   FE87               CPI  087H
 0052   C24600             JNZ  ALPHA       ;IF NOT LOOP,ELSE DONE
                    ;
                    ; POINTER/BUFFER CLEAR
                    ;
 0055   210000      NXT2:  LXI  H,0
 0058   22D387             SHLD RCTAD       ;ZERO ROW COUNT
 005B   22E287             SHLD LOCBUF      ;ZERO BUFFER
 005E   22D887             SHLD LOCAD       ;ZERO CHAR. LOCATION
1
 8080 MACRO ASSEMBLER, VER 2.0   ERRORS = 0 PAGE 2
 0061   22DA87             SHLD LOC01       ;ZERO 1ST CHAR IN ROW
 0064   22DC87             SHLD LOC80       ;ZERO 80TH CHAR IN ROW
 0067   22DE87             SHLD LOCXX       ;ZERO LOC OF 1ST CHAR
 006A   22E087             SHLD LOCPR       ;ZERO LOC OF 1ST CHAR
 006D   210080             LXI  H,8000H     ;POINT TO TOP OF SCREEN
 0070   22D687             SHLD TOPAD       ;SET TOP=8000H
 0073   218087             LXI  H,8780H     ;POINT TO BOT OF SCREEN
 0076   22E687             SHLD BOTAD       ;SET BOT=8780H
 0079   3E00               MVI  A,0
 007B   32D287             STA  CCTAD       ;ZERO COLUMN COUNT
 007E   32D587             STA  CURSY       ;SET CURSOR Y POINTER
 0081   32E487             STA  XFLG        ;ZERO ESC SEQ FLAG
 0084   32E587             STA  USCHR       ;ZERO 8251 CHAR BUFF
                    ;
                    ; INITIALIZE 8251
                    ;
 0087   3E7B               MVI  A,07BH
 0089   D301               OUT  CNCTL
 008B   3E27               MVI  A,027H
 008D   D301               OUT  CNCTL
                    ;
                    ; INITIALIZE 8279
                    ;
 008F   3E3F               MVI  A,03FH      ;DIVIDE BY 31
 0091   D361               OUT  KCOM
                    ;
                    ; INITIALIZE 8275
                    ;
 0093   3E00               MVI  A,0         ;RESET & STOP DISPLAY
 0095   D351               OUT  CRCOM
 0097   3E4F               MVI  A,04FH      ;SCREEN PARAM BYTE 1
 0099   D350               OUT  CRDAT
 009B   3E58               MVI  A,058H      ;SCREEN PARAM BYTE 2
 009D   D350               OUT  CRDAT
 009F   3E89               MVI  A,089H      ;SCREEN PARAM BYTE 3
 00A1   D350               OUT  CRDAT
 00A3   3E59               MVI  A,059H      ;SCREEN PARAM BYTE 4
 00A5   D350               OUT  CRDAT
 00A7   3E80               MVI  A,080H      ;CURSOR POSITION
 00A9   D351               OUT  CRCOM
 00AB   3E00               MVI  A,0         ;X CURSOR POSITION
 00AD   D350               OUT  CRDAT
 00AF   3E00               MVI  A,0         ;Y CURSOR POSITION
 00B1   D350               OUT  CRDAT
 00B3   3EE0               MVI  A,0E0H      ;PRESET COUNTERS
 00B5   D351               OUT  CRCOM
 00B7   3E23               MVI  A,023H      ;START DISPLAY
 00B9   D351               OUT  CRCOM
 00BB   CD6704             CALL RT75        ;SET UP 8257
 00BE   DB01        LOOP:  IN   CNCTL       ;CHECK FOR CHAR REC.
 00C0   E602               ANI  002H
1
 8080 MACRO ASSEMBLER, VER 2.0   ERRORS = 0 PAGE 3


 00C2   C4D200             CNZ  AGGIE       ;READ CHAR IN 8251
 00C5   DB51               IN   CRCOM       ;READ 8275 STATUS
```

Listing 2 continued on page 132

The VP-111 hobby computer: Start programming for only $99.





New! VP-111 Microcomputer.... $99. Assembled* and tested.

Features:

- RCA 1802 Microprocessor.
- 1K Bytes static RAM.

Expandable on-board to 4K.
Expandable to 32K Bytes total.

- 512 Byte ROM operating system.
- CHIP-8 interpretive language or machine language programmable.
- Hexidecimal keypad.
- Audio tone generator.
- Single 5-volt operation.
- Video output to monitor or modulator.
- Cassette interface—100 Bytes/sec.
- Instruction Manual with 5 video game listings, schematics, CHIP-8, much more!

Ideal for low-cost control applications.

Expandable to full VP-711 capability with VP-114 Kit.

*User need only connect cables (included), a 5-volt power supply and speaker.

New low price! VP-711, only.......... $199. Completely assembled and tested.

All the features of the VP-111 plus:

- A total of 2K Bytes static RAM.
- Power supply.
- 8 Bit input port.
- 8 Bit output port.
- I/O port connector.
- System expansion connector.
- Built-in speaker.
- Plastic cover.

Three comprehensive manuals:

- Instruction Manual—20 video game listings, schematics, much more.
- User's Guide—operating instructions and CHIP-8 for the beginner.
- RCA 1802 User's Manual (MPM-201B)—complete 1802 reference guide.

Add computer power a board at a time.

With easy-to-buy options, the versatile RCA hobby computer means even more excitement. More challenges in graphics, games and control functions. For everyone, from youngster to serious hobbyist.

Built around an RCA COSMAC microprocessor, our hobby computer is easy to program and operate. Powerful CHIP-8 interpretive language gets you into programming the first evening. Complete documentation provided.

Send the coupon now...
Complete the coupon below and mail to: RCA MicroComputer Customer Service, New Holland Ave., Lancaster, PA 17604.

Or call toll free (800) 233-0094 to place your Master Charge or VISA credit card order. In Pennsylvania, call (717) 397-7661, extension 3179.

RCA

Please send me the items indicated.

- ☐ **VP-111** New low cost Microcomputer (See description above) .... $ 99
- ☐ **VP-114** Expansion Kit for VP-111—Includes 3K RAM, I/O Port and connectors $ 76
- ☐ **VP-711** The original VIP Microcomputer (See description above) $199
- ☐ **VP-44** RAM On-Board Expansion Kit—Four 2114 RAM ICs. Expands VP-711 memory to 4K Bytes .... $ 36
- ☐ **VP-590** Color Board—Adds color. Four background and eight foreground colors .... $ 69
- ☐ **VP-595** Simple Sound Board—Provides 256 programmable frequencies. For simple music or sound effects. Includes speaker .... $ 30
- ☐ **VP-550** Super Sound Board—Turns VP-111/711 into a music synthesizer! Two independent sound channels. Outputs to audio .... $ 49
- ☐ **VP-551** 4-Channel Super Sound—Includes VP-576 and demo cassette. Requires VP-550 and 4K RAM .... $ 74
- ☐ **VP-570** Memory Expansion Board—Plug-in 4K RAM memory .... $ 95
- ☐ **VP-580** Auxillary Keypad—Adds two-player interactive capability. Connects to VP-590 or VP-585 .... $ 20
- ☐ **VP-585** Keypad Interface Board—Interfaces two VP-580 Auxiliary Keypads to VP-111/711 .... $ 15
- ☐ **VP-560** EPROM Board—Interfaces two 2716 EPROMS to VP-111/711 .. $ 34
- ☐ **VP-565** EPROM Programmer Board—Programs 2716 EPROMs. With software .... $ 99
- ☐ **VP-575** Expansion Board—Provides 4 buffered and one unbuffered expansion sockets .... $ 59
- ☐ **VP-576** Two-Board Expander—Allows use of 2 Accessory Boards in either I/O or Expansion Socket .... $ 20
- ☐ **VP-700** Tiny BASIC ROM Board—BASIC code stored in 4K of ROM .... $ 39
- ☐ **VP-701** Floating point BASIC for VP-711 on cassette. Requires 16K Bytes RAM (avail. 7/80) .... $ 49
- ☐ **VP-710** Game Manual—Listing for 16 exciting games .... $ 10
- ☐ **VP-720** Game Manual-II—More games .. $ 15

ASCII keyboards.

- ☐ **VP-601** Keyboard—128-character ASCII encoded alphanumeric 8-bit parallel output .... $ 69
- ☐ **VP-606** Keyboard—Same as VP-601. Asynchronous serial output ..... $ 99
- ☐ **VP-611** Keyboard—Same as VP-601 plus 16-key numeric keypad .... $ 89
- ☐ **VP-616** Keyboard—Same as VP-606 plus 16-key numeric keypad $119
- ☐ **VP-620** Cable—Connects VP-601/611 to VP-111/711 .... $ 20
- ☐ **VP-623** Cable—Unterminated for VP-601/611 .... $ 20
- ☐ **VP-626** Connector—Male "D" mates to VP-606/616 .... $ 7

Enclosed is $_____ for items checked plus shipping & handling charge of $3.00.
Add your state and local taxes $_____ Total enclosed $_____
I enclose ☐ check or ☐ money order. Or charge my ☐ VISA ☐ Master Charge.
Credit card account No. ____________
Master Charge Interbank No. ____________ Expiration date ____________
Signature (required for credit orders): ____________
Name (please type or print): ____________
Street address: ____________ City: ____________
State & Zip: ____________ Telephone:( ) ____________
Make checks payable to RCA Corp. Prices and specifications are subject to change without notice.

Circle 88 on inquiry card.

Listing 2 continued from page 130:

```
00C7    E620           ANI   020H        ;MASK INTERUPT BIT
00C9    C46704         CNZ   RT75        ;SERVICE 8257 IF INT
00CC    CDA004         CALL  KPOLL       ;CHECK FOR KEYPRESS
00CF    C3BE00         JMP   LOOP
                ;
                ; SERVICE 8251 AND ENTER CHAR INTO DISPLAY
                ;
00D2    CDD900  AGGIE: CALL  RDF51       ;READ 8251
00D5    CDE100         CALL  CHREC       ;CHAR HANDLING ROUTINE
00D8    C9             RET
                ;
                ; 8251 READ CHAR SUBROUTINE
                ;
00D9    DB00    RDF51: IN    CNIN        ;IN CHAR FROM 8251
00DB    E67F           ANI   07FH        ;MASK OFF BIT 8
00DD    32E587         STA   USCHR       ;STORE THE CHAR
00E0    C9             RET
                ;
                ; CHARACTER HANDLING ROUTINE
                ;
00E1    3AE487  CHREC: LDA   XFLG        ;LOAD ESC FLAG
00E4    E6FF           ANI   0FFH        ;SET/RESET ZERO FLAG
00E6    CAED00         JZ    NXTX        ;1=2ND CHAR ESC SEQ
00E9    CD0B01         CALL  ESREC       ;ESC SEQ ROUTINE
00EC    C9             RET
00ED    3AE587  NXTX:  LDA   USCHR       ;LOAD UART CHAR
00F0    E660           ANI   060H        ;MASK ALL BUT BIT 6&7
00F2    CAF900         JZ    NXTY        ;0=CTRL,1=DISPLAY CHAR
00F5    CD4103         CALL  DISPL       ;DISPLAY CHAR ROUTINE
00F8    C9             RET
00F9    3AE587  NXTY:  LDA   USCHR       ;LOAD UART CHAR
00FC    E610           ANI   010H        ;MASK ALL BUT BIT 5
00FE    C20501         JNZ   NXTZ        ;0=CTRL,1=ESC SEQ
0101    CD2301         CALL  CNTRL       ;CTRL CODE ROUTINE
0104    C9             RET
0105    21E487  NXTZ:  LXI   H,XFLG      ;POINT TO ESC FLAG
0108    3601           MVI   M,1         ;SET ESC SEQ FLAG
010A    C9             RET
                ;
                ; ESCAPE SEQUENCE ROUTINE
                ;
010B    3E00    ESREC: MVI   A,0         ;ZERO A
010D    32E487         STA   XFLG        ;RESET ESC FLAG
0110    3AE587         LDA   USCHR       ;LOAD UART CHAR
0113    E60F           ANI   00FH        ;MASK OFF HIGH 4 BITS
0115    07             RLC               ;SHIFT L FOR OFFSET
0116    21C104         LXI   H,BSET1     ;BASE ADD TABLE 1
0119    110000         LXI   D,0
011C    5F             MOV   E,A         ;MOVE OFFSET TO DE
1
 8080 MACRO ASSEMBLER, VER 2.0  ERRORS = 0 PAGE 4


011D    19             DAD   D           ;ADD OFFSET TO BASE
011E    5E             MOV   E,M         ;LOAD VECTOR IN DE
011F    23             INX   H
0120    56             MOV   D,M
0121    EB             XCHG              ;VECTOR TO HL
0122    E9             PCHL              ;VECTOR TO PC
                ; CONTROL CODE ROUTINE
                ;
0123    3AE587  CNTRL: LDA   USCHR       ;LOAD UART CHAR
0126    E606           ANI   006H        ;SAVE BITS 2+3
0128    21E104         LXI   H,BSET2     ;BASE ADD TABLE 2
012B    110000         LXI   D,0
012E    5F             MOV   E,A         ;MOVE OFFSET TO DE
012F    19             DAD   D           ;ADD OFFSET TO BASE
0130    5E             MOV   E,M         ;LOAD VECTOR IN DE
0131    23             INX   H
0132    56             MOV   D,M
0133    EB             XCHG              ;VECTOR TO HL
0134    E9             PCHL              ;VECTOR TO PC
                ;
                ; CURSOR UP ROUTINE
                ;
0135    2AD387  ESCA:  LHLD  RCTAD       ;LOAD ROWCOUNT IN HL
0138    7D             MOV   A,L         ;LOW BYTE TO A
0139    FE00           CPI   0           ;IS IT ZERO?
013B    CA4201         JZ    ALPH        ;IF ZERO CONTINUE
013E    CDFE02         CALL  ROWUP
0141    C9             RET
0142    7C      ALPH:  MOV   A,H         ;HIGH BYTE IN A
0143    FE00           CPI   0           ;IS IT ZERO?
0145    CA4C01         JZ    BETA        ;IF 0,ROW=1ST ROW
0148    CDFE02         CALL  ROWUP
014B    C9             RET
014C    218007  BETA:  LXI   H,0780H     ;ROWCOUNT=LAST ROW
                                         ;(1920 DECIMAL)
014F    22D387         SHLD  RCTAD       ;STORE IN ROWCNT BUFF
0152    3E18           MVI   A,018H      ;18H TO CURS Y BUFF
0154    32D587         STA   CURSY       ;CURSOR Y-POS=LAST ROW
0157    CD3203         CALL  WP75        ;LOAD CURSOR POS SUB
015A    C9             RET
                ;
                ; CURSOR DOWN ROUTINE
                ;
015B    2AD387  ESCB:  LHLD  RCTAD       ;ROWCOUNT TO HL
015E    7D             MOV   A,L         ;LOW BYTE TO A
015F    FE80           CPI   080H        ;IS IT 80H ?
0161    CA6801         JZ    GAMMA       ;IF BYTE=80H THEN CONTINUE
0164    CD1003         CALL  ROWDN       ;ROWDOWN SUB.
0167    C9             RET
0168    7C      GAMMA: MOV   A,H         ;HIGH BYTE TO A
1
 8080 MACRO ASSEMBLER, VER 2.0  ERRORS = 0 PAGE 5


0169    FE07           CPI   007H        ;IS IT 7 ?
016B    CA7201         JZ    DELTA       ;IF=7,ROWCNT.=LAST ROW
016E    CD1003         CALL  ROWDN       ;ROWDOWN SUB.
0171    C9             RET
0172    CD3203  DELTA: CALL  WP75        ;CURSOR POS ROUTINE
0175    CDFF03         CALL  SCROL       ;SCROLL SUBROUTINE
0178    C9             RET
                ;
                ;CURSOR RIGHT ROUTINE
                ;
0179    3AD287  ESCC:  LDA   CCTAD       ;COL.CNT. TO A
017C    FE4F           CPI   04FH        ;IS IT 4FH ?
017E    CA8501         JZ    ZETA        ;IF=4FH COL. CNT =
```

Listing 2 continued on page 134

YOUR COMPUTER PROFESSIONALS

computique

PERSONAL ELECTRONICS AT PROFESSIONAL DISCOUNTS

SIX STORES IN SOUTHERN CALIFORNIA

OUTSIDE CALIFORNIA ORDER LINE **(800) 854-0523**

CALIFORNIA ORDER AND INFORMATION LINE **(714) 549-7373**

INTRODUCING



apple ///

Apple III is a highly integrated computer system, evolved from the Apple II design and optimized to best serve the professional user. The new computer will be offered in packaged configurations for personal use in professional applications. Look at these special Apple III features: • an 80-character upper/lower case display disc drive and integrated peripheral interfaces • enanced graphics capibility • an emulsion mode allowing Apple II software to be run on the Apple III



COMPLETE BUSINESS, EDUCATIONAL AND GAME SOFTWARE AVAILABLE

THE HP-85!

HEWLETT PACKARD'S PERSONAL COMPUTER FOR PROFESSIONALS!

The HP-85 is a powerful BASIC language computer complete with keyboard, CRT display, printer, and tape drive—all in one compact unit.

We will meet or beat any competitor's price if he has the merchandise on hand.

HEWLETT PACKARD

MORE HP VALUES

HP 41C Basic Calculator and Complete System . . . CALL

HP-67	$299.95	HP-31E	41.95
HP-92	399.95	HP 32E	54.95
HP 97	584.95	HP 33E	73.95
HP 33C NEW	99.95	HP 37E	59.95
HP-34C NEW	124.95	HP 38E	104.95
HP 38C NEW	124.95		

Now-the Texas Instruments TI-99/4 Home Computer

$699 95

SUGG. RETAIL $950.00

MONITOR NOT INCLUDED

You can begin using the TI Home Computer in minutes. Without any previous computer experience. You simply snap in one of TI's Solid State Software™ Command Modules. Step-by-step instructions are displayed right on the screen.



TEXAS INSTRUMENTS INCORPORATED

TI-35SP NEW	$24.95	PC 100C	169.95	BA II Exec. NEW	44.95
TI-50	33.50	TI 5015	64.95	Invest. Anal. NEW	49.95
TI-55	34.95	TI 5040	89.95	Business Card NEW	39.95
TI-57	54.95	TI 5100	$39.95	Language Translator NEW	249.95
TI-58C NEW	109 95	Programmer	54.95	Language Modules ea.	54.95
TI 59	209.95	MBA	59.95	Speak & Spell	54.95
TI 58/59 Libraries	35.00	Business Analyst I	21.95	Modules ea.	14.95
TI-30SP	17.95			Chrono Alarm 806-31	39.95

SHARP

6200 NEW EXECUTIVE	99.95
5813 NEW PROGRAMMABLE	34.95
5100 NEW LCD Alphanumeric	89.95
5102 NEW	79.95
7000 NEW Memo Writer	99.95

BSR SYSTEM X-10 COMMAND . . . 39.95 Each Module . . . 16.95

MATTEL ELECTRONICS Intellivision 299.95

CODE-A-PHONE

1450 . . . . 224.95

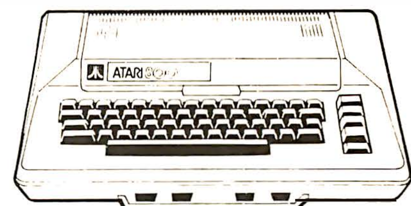
1500 . . . . 279.95

CHESS CHALLENGER "7" 89.95

ALSO: Canon, Seiko, Craig, Sanyo, Mattel, Pearlcorder, Record-a-Call, Casio, And Many Others. ALL AT GREAT PRICES!

ATARI® 800

PERSONAL COMPUTER SYSTEM



Plot your investment strategy with confidence. Take the guesswork out of business decisions. Organize your household finances. Control your tax options. Come in and find out why some very shrewd people now own the versatile Atari Personal Computer System.

$899 95 NOW! 16K



MORE ATARI

ATARI 810 Disc Drive 559.95

ATARI 820 40-Column Printer 479.95

PLUS Complete Entertainment & Educational Software

Send Orders to Dept BY-Sept

NEWPORT BEACH/COSTA MESA	FULLERTON	TORRANCE/LAWNDALE	LOS ANGELES	TARZANA	PASADENA
3211 So. Harbor Blvd.	2514 E. Chapman Ave.	16611 Hawthorne Blvd.	11986 Wilshire Blvd.	18665 Ventura Blvd.	260 So. Lake Ave.
Santa Ana, CA 92704	Fullerton	Lawndale	Los Angeles	Tarzana	Pasadena
1 Mi. North of San Diego Fwy. (405)	Corner of State College & Chapman	4 Blks. South of San Diego Fwy.	8 Blks. West of San Diego Fwy.	2 Blks. West of Reseda Blvd.	Lake Avenue District
(714) 549-7373	(714) 738-7775	(213) 370-5795	(213) 820-0423	(213) 705-7507	(213) 795-3007

WE WILL BEAT OR MEET ANY COMPETITOR S PRICE ON MOST ITEMS IF HE HAS THE MERCHANDISE ON HAND. All units shipped in original factory cartons with accessories according to manufacturer's specification. **CALL TOLL FREE (800) 854-0523** (outisde CA) or **(714) 549-7373** (within CA). VISA and Master Charge, money order, Pers. Ck. (14 working days to clear), COD accepted. Min. $4.95 for shipping in USA. We ship AIR on request. CA residents add 6% sales tax. All merchandise subject to availability. Prices good only with this ad for limited time only. **WRITE OR CALL FOR FREE CATALOG**

Circle 87 on inquiry card.

Listing 2 continued from page 132:

```
                                         ;LAST CHAR IN ROW
0181    CD2A03          CALL COLRT       ;COL. RIGHT SUB.
0184    C9              RET
0185    2AD387   ZETA:  LHLD RCTAD       ;ROWCOUNT TO HL
0188    7D              MOV  A,L         ;LOW BYTE TO A
0189    FE80            CPI  080H        ;IS IT 80H ?
018B    C29401          JNZ  CCTOA       ;IF=80H CONTINUE
018E    7C              MOV  A,H         ;HIGH BYTE TO A
018F    FE07            CPI  007H        ;IS IT 7 ?
0191    CA9D01          JZ   CCTOB       ;IF 7,ROWCNT.=LAST ROW
0194    3E00     CCTOA: MVI  A,0
0196    32D287          STA  CCTAD       ;ZERO COL. CNT. BUF
0199    CD1003          CALL ROWDN       ;ROWDOWN SUBROUTINE
019C    C9              RET
019D    3E00     CCTOB: MVI  A,0
019F    32D287          STA  CCTAD       ;ZERO COL. CNT. BUF
01A2    CD3203          CALL WP75        ;CURSOR POS. ROUTINE
01A5    CDFF03          CALL SCROL       ;SCROLL ROUTINE
01A8    C9              RET
                 ;
                 ; CURSOR LEFT ROUTINE
                 ;
01A9    3AD287   ESCD:  LDA  CCTAD       ;COL. CNT. TO A
01AC    FE00            CPI  0           ;IS IT ZERO ?
01AE    CAB501          JZ   NXTA        ;IF=0 COL. CNT.=
                                         ;1ST CHAR IN ROW
01B1    CD2203          CALL COLLT       ;COLUMN LEFT SUB.
01B4    C9              RET
01B5    2AD387   NXTA:  LHLD RCTAD       ;ROWCOUNT TO HL
01B8    7D              MOV  A,L         ;LOW BYTE TO A
01B9    FE00            CPI  0           ;IS IT ZERO ?
01BB    C2C401          JNZ  CCTMA       ;IF BYTE=0 CONTINUE
01BE    7C              MOV  A,H         ;HIGH ROWCNT. TO A
01BF    FE00            CPI  0           ;IS IT ZERO ?
01C1    CACD01          JZ   CCTMB       ;IF 0,HOME POS EXISTS
01C4    3E4F     CCTMA: MVI  A,04FH      ;SET COLUMN COUNT
01C6    32D287          STA  CCTAD       ;TO 4FH
01C9    CDFE02          CALL ROWUP       ;CALL ROWUP ROUTINE
1
 8080 MACRO ASSEMBLER, VER 2.0   ERRORS = 0 PAGE 6

01CC    C9              RET
01CD    218007   CCTMB: LXI  H,0780H     ;ROWCNT. = 780H
01D0    22D387          SHLD RCTAD       ;(1920D)
01D3    3E4F            MVI  A,04FH      ;SET COLUMN COUNT
01D5    32D287          STA  CCTAD       ;TO 4FH
01D8    3E18            MVI  A,018H      ;LOAD CURSOR WITH
01DA    32D587          STA  CURSY       ;18H=24D,LAST LINE
01DD    CD3203          CALL WP75        ;LOAD CURSOR ROUTINE
01E0    C9              RET
                 ;
                 ; HOME ROUTINE
                 ;
01E1    210000   ESCH:  LXI  H,0         ;ZERO HL
01E4    22D387          SHLD RCTAD       ;SET ROWCOUNT=0
01E7    3E00            MVI  A,0         ;ZERO A
01E9    32D287          STA  CCTAD       ;COLUMN CNT.=0
01EC    32D587          STA  CURSY       ;CURSOR Y PNTR=0
01EF    CD3203          CALL WP75        ;LOAD CURSOR ROUTINE
01F2    C9              RET
                 ;
                 ; ERASE LINE ROUTINE
                 ;
01F3    2AD687   ESCK:  LHLD TOPAD       ;LOAD TOP IN HL
01F6    EB              XCHG             ;MOVE TO DE
01F7    2AD387          LHLD RCTAD       ;ROWCOUNT IN HL
01FA    19              DAD  D           ;TOP+ROWCOUNT
01FB    22DE87          SHLD LOCXX       ;STORE RESULT
01FE    3E87            MVI  A,087H      ;87H TO A
0200    BC              CMP  H           ;COMPARE TO 87H
0201    D20A02          JNC  FRODO       ;NO CARRY=CONT.
0204    CD2002          CALL COMRX       ;COMPENSATION ROUT.
0207    C31602          JMP  BILBO
020A    C21602   FRODO: JNZ  BILBO       ;IF NO 0 END COMPARE
020D    3ECF            MVI  A,0CFH      ;CFH TO A
020F    BD              CMP  L           ;COMPARE TO CFH
0210    D21602          JNC  BILBO       ;IF NC,LOCXX<=87CFH
0213    CD2002          CALL COMRX       ;IF C,COMPENSATE
0216    2ADE87   BILBO: LHLD LOCXX       ;LOCXX TO HL
0219    22E287          SHLD LOCBUF      ;STORE IN BUFFER
021C    CD2604          CALL FILL        ;FILL ROW WITH SPACES
021F    C9              RET
                 ;
                 ; COMPENSATION ROUTINE
                 ;
0220    2ADE87   COMRX: LHLD LOCXX       ;LOCXX TO HL
0223    1130F8          LXI  D,0F830H    ;COMP VALUE TO DE
0226    19              DAD  D           ;SUM THE TWO
0227    22DE87          SHLD LOCXX       ;STORE SUM
022A    C9              RET
                 ;
                 ; CLEAR SCREEN ROUTINE
1
 8080 MACRO ASSEMBLER, VER 2.0   ERRORS = 0 PAGE 7
                 ;
022B    3EF0     ESCE:  MVI  A,0F0H      ;EOR CHAR. TO A
022D    0619            MVI  B,019H      ;25 LINES TO B
022F    115000          LXI  D,050H      ;80 CHAR LINE TO DE
0232    210080          LXI  H,8000H     ;STARTING ADDRESS
0235    77       LOADX: MOV  M,A         ;EOR CHAR. TO MEM.
0236    19              DAD  D           ;ADD 80 TO HL
0237    05              DCR  B           ;DEC LINE COUNT
0238    C23502          JNZ  LOADX       ;LOOP
023B    210000          LXI  H,0         ;ZERO HL
023E    22D387          SHLD RCTAD       ;ZERO ROWCOUNT
0241    210080          LXI  H,8000H     ;BEGIN ADDRESS
0244    22D687          SHLD TOPAD
0247    218087          LXI  H,8780H     ;END ADDRESS
024A    22E687          SHLD BOTAD
024D    3E00            MVI  A,0         ;ZERO A
024F    32D287          STA  CCTAD       ;ZERO COLUMN COUNT
0252    32D587          STA  CURSY       ;ZERO CURSOR Y POS
0255    32E487          STA  XFLG        ;ZERO ESC SEQ FLAG
0258    CD3203          CALL WP75        ;LOAD CURSOR POS
025B    C9              RET
                 ;
                 ; ERASE TO END OF SCREEN ROUTINE
                 ;
025C    2AD687   ESCJ:  LHLD TOPAD       ;TOP TO HL
025F    EB              XCHG             ;MOVE TO DE
0260    2AD387          LHLD RCTAD       ;ROW COUNT TO HL
```

Listing 2 continued on page 136

Listing 2 continued from page 134:

```
0263    19             DAD  D          ;SUM=POS OF 1ST CHAR
                                       ;IN PRESENT ROW
0264    22E087         SHLD LOCPR      ;STORE IN MEM
0267    3E87           MVI  A,087H     ;87H TO A
0269    BC             CMP  H          ;COMPARE TO 87H
026A    D27302         JNC  VAR        ;NC=CONT COMPARE
026D    CDE402         CALL COMRY      ;COMPENSATE ROUTINE
0270    C37F02         JMP  FIN
0273    C27F02  VAR:   JNZ  FIN        ;IF NE END COMPARE
0276    3ECF           MVI  A,0CFH     ;CFH TO A
0278    BD             CMP  L          ;COMPARE TO LOW BYTE
0279    D27F02         JNC  FIN        ;NC MEANS <= 87CFH
027C    CDE402         CALL COMRY      ;COMPENSATION ROUT.
027F    2AD687  FIN:   LHLD TOPAD      ;TOP TO HL
0282    7D             MOV  A,L        ;LOW BYTE TO A
0283    FE00           CPI  0          ;IS IT ZERO?
0285    C29702         JNZ  TROLL      ;IF NOT TO TROLL
0288    7C             MOV  A,H        ;HIGH BYTE TO A
0289    FE80           CPI  080H       ;IS IT 80H ?
028B    C29702         JNZ  TROLL      ;IF NOT TO TROLL
028E    218087         LXI  H,8780H    ;BOTTOM=8780H
0291    22E687         SHLD BOTAD      ;STORE IN MEM
0294    C3A102         JMP  GNOME      ;JUMP TO GNOME
0297    11B0FF  TROLL: LXI  D,0FFB0H   ;-80D TO DE
1
 8080 MACRO ASSEMBLER, VER 2.0  ERRORS = 0 PAGE 8


029A    2AD687         LHLD TOPAD      ;STORE IN MEM
029D    19             DAD  D          ;ADD -80D TO TOP
029E    22E687         SHLD BOTAD      ;STORE IN MEM
02A1    3EF0    GNOME: MVI  A,0F0H     ;EOR CHAR TO A
02A3    2AE087         LHLD LOCPR      ;LOCPR TO HL
02A6    77             MOV  M,A        ;EOR CHAR TO MEM
02A7    7D             MOV  A,L        ;LOW BYTE TO A
02A8    FE80           CPI  080H       ;IS IT 80H ?
02AA    C2CB02         JNZ  WIZAR      ;IF NOT TO WIZAR
02AD    7C             MOV  A,H        ;HIGH BYTE TO A
02AE    FE87           CPI  087H       ;IS IT 87H ?
02B0    C2CB02         JNZ  WIZAR      ;IF NOT TO WIZAR
02B3    EB      GZONK: XCHG            ;PRESENT LOC TO DE
02B4    2AE687         LHLD BOTAD      ;BOTTOM TO HL
02B7    7D             MOV  A,L        ;LOW BYTE TO A
02B8    BB             CMP  E          ;DOES E=A
02B9    C2C202         JNZ  FUN        ;IF NOT TO FUN
02BC    7C             MOV  A,H        ;HIGH BYTE TO A
02BD    BA             CMP  D          ;DOES D=A
02BE    C2C202         JNZ  FUN        ;IF NOT TO FUN
02C1    C9             RET
02C2    210080  FUN:   LXI  H,8000H    ;8000H TO HL
02C5    22E087         SHLD LOCPR      ;SET POCPR TO 8000H
02C8    C3A102         JMP  GNOME      ;LOOP
02CB    EB      WIZAR: XCHG            ;LOCPR TO DE
02CC    2AE687         LHLD BOTAD      ;BOTTOM TO HL
02CF    7D             MOV  A,L        ;LOW BYTE TO A
02D0    BB             CMP  E          ;DOES E=A
02D1    C2DA02         JNZ  NUF        ;IF NOT TO NUF
02D4    7C             MOV  A,H        ;HIGH BYTE TO A
02D5    BA             CMP  D          ;DOES D=A
02D6    C2DA02         JNZ  NUF        ;IF NOT TO NUF
02D9    C9             RET
02DA    215000  NUF:   LXI  H,050H     ;LOAD 80D IN HL
02DD    19             DAD  D          ;ADD 80D TO LOCPR
02DE    22E087         SHLD LOCPR      ;STORE SUM IN MEM
02E1    C3A102         JMP  GNOME      ;LOOP
                ;
                ; COMPENSATION ROUTINE
                ;
02E4    2AE087  COMRY: LHLD LOCPR      ;LOCPR TO HL
02E7    1130F8         LXI  D,0F830H   ;COMP VALUE TO DE
02EA    19             DAD  D          ;ADD COMP TO LOCPR
02EB    22E087         SHLD LOCPR      ;STORE IN MEM
02EE    C9             RET
                ;
                ; LINE FEED ROUTINE
                ;
02EF    C35B01  CTRLJ: JMP  ESCB       ;CURSOR DOWN 1 LINE
                ;
                ; CARRIAGE RETURN ROUTINE
1
 8080 MACRO ASSEMBLER, VER 2.0  ERRORS = 0 PAGE 9


                ;
02F2    3E00    CTRLM: MVI  A,0        ;ZERO A
02F4    32D287         STA  CCTAD      ;COLUMN CNT. = 0
02F7    CD3203         CALL WP75       ;LOAD CURSOR POS.
02FA    C9             RET
                ;
                ; BACK SPACE ROUTINE
                ;
02FB    C3A901  CTRLH: JMP  ESCD       ;MOVE CURSOR LEFT 1
                ;
                ; ROWUP ROUTINE
                ;
02FE    2AD387  ROWUP: LHLD RCTAD      ;ROWCOUNT TO HL
0301    11B0FF         LXI  D,0FFB0H   ;-80D TO DE
0304    19             DAD  D          ;ADD -80D TO ROWCOUNT
0305    22D387         SHLD RCTAD      ;STORE IN MEM
0308    21D587         LXI  H,CURSY    ;CURSOR Y TO HL
030B    35             DCR  M          ;DECREMENT CURS Y
030C    CD3203         CALL WP75       ;LOAD CURSOR POS
030F    C9             RET
                ;
                ; ROWDOWN ROUTINE
                ;
0310    2AD387  ROWDN: LHLD RCTAD      ;ROWCOUNT TO HL
0313    115000         LXI  D,050H     ;+80D TO DE
0316    19             DAD  D          ;ADD +80D TO ROWCOUNT
0317    22D387         SHLD RCTAD      ;STORE IN MEM
031A    21D587         LXI  H,CURSY    ;CURSOR Y TO HL
031D    34             INR  M          ;INCREMENT CURS Y
031E    CD3203         CALL WP75       ;LOAD CURSOR POS
0321    C9             RET
                ;
                ; COLUMN LEFT ROUTINE
                ;
0322    21D287  COLLT: LXI  H,CCTAD    ;COL CNT TO HL
0325    35             DCR  M          ;DCR COL COUNT
0326    CD3203         CALL WP75       ;LOAD CURSOR POS
0329    C9             RET
```

Listing 2 continued on page 138

The easy way to learn about computers: BUILD ONE



Yes, you can do it. Heath makes it simple with easy-to-build kits and step-by-step assembly manuals that lead you from unpacking to final plug-in.

And once you build your own computer, you'll know it inside-out. You'll know how to make it work for you.

Software, designed especially for Heathkit Computers, includes innovative programs for running your home or business, and exciting games your kids will enjoy.

The Heathkit User's Group (HUG), made up of owners of Heathkit Computers, will share with you a library of over 400 programs that they've written to make your computer serve you in ways you never imagined.

Heathkit Computers may be low-cost kits. But they're not playthings. They're powerful, high-capacity computers designed for complex programming. You'll find complete systems — hardware, software, accessories — within the pages of the colorful, 104-page, Free Heathkit Catalog. And you'll find service any time you need it at 55 locations throughout the U.S. or at the Heathkit factory.

FREE CATALOG

For complete descriptions of Heathkit Computers, send for the latest, free Heathkit Catalog.

If Coupon is missing write: Heath Co., Dept. 334-692, Benton Harbor, MI 49022

In Canada, write Heath Company, 1480 Dundas Hwy. East, Mississauga, Ontario L4X 2R7

Heathkit Products are also sold and serviced at Heathkit Electronic Centers (units of Veritechnology Electronics Corp. in the U.S.) throughout the U.S. and Canada. See your white pages. DEC is a registered trademark of Digital Equipment Corporation.

Heathkit | **Heath Company, Dept. 334-692, Benton Harbor, MI 49022**

☐ YES Please send me my FREE Heathkit Catalog.
I am not currently receiving your catalogs.

Name ____________________

Address ____________________

City ____________________ State ____________

CP-182 Zip ____________

Listing 2 continued from page 136:

```
                        ; COLUMN RIGHT ROUTINE
                        ;
032A    21D287          COLRT:  LXI     H,CCTAD         ;COL CNT TO HL
032D    34                      INR     M               ;INR COL COUNT
032E    CD3203                  CALL    WP75            ;LOAD CURSOR POS
0331    C9                      RET
                        ;
                        ; LOAD CURSOR POSITION ROUTINE
                        ;
0332    3E80            WP75:   MVI     A,080H          ;LOAD CUR POS COMMAND
0334    D351                    OUT     CRCOM
0336    3AD287                  LDA     CCTAD           ;A=CURSOR X POSITION
1
 8080 MACRO ASSEMBLER, VER 2.0   ERRORS = 0 PAGE 10


0339    D350                    OUT     CRDAT
033B    3AD587                  LDA     CURSY           ;A=CURSOR Y POSITION
033E    D350                    OUT     CRDAT
0340    C9                      RET
                        ;
                        ; DISPLAY CHAR HANDLING ROUTINE
                        ;
0341    3AD287          DISPL:  LDA     CCTAD           ;COLUMN CNT TO A
0344    FE4F                    CPI     04FH            ;DOES IT = 79D
0346    CA5003                  JZ      CTA             ;IF 79D, LAST CHAR
                                                        ;IN THE ROW
0349    CD7403                  CALL    DIS1
034C    CDB103                  CALL    DISA
034F    C9                      RET
0350    2AD387          CTA:    LHLD    RCTAD           ;ROWCOUNT TO HL
0353    7D                      MOV     A,L             ;LOW BYTE TO A
0354    FE80                    CPI     080H            ;IS IT 80H ?
0356    CA6003                  JZ      CTB             ;IF=80H CONT COMPARE
0359    CD7403                  CALL    DIS1
035C    CDB903                  CALL    DISB
035F    C9                      RET
0360    7C              CTB:    MOV     A,H             ;HIGH BYTE TO A
0361    FE07                    CPI     007H            ;IS IT 7 ?
0363    CA6D03                  JZ      CTC             ;IF=7,END OF DISPLAY
0366    CD7403                  CALL    DIS1
0369    CDB903                  CALL    DISB
036C    C9                      RET
036D    CD7403          CTC:    CALL    DIS1
0370    CDD003                  CALL    DISC
0373    C9                      RET
                        ;
                        ; SUBROUTINE DIS1
                        ;
0374    2AD687          DIS1:   LHLD    TOPAD           ;TOPAD TO HL
0377    EB                      XCHG                    ;MOVE IT TO DE
0378    2AD387                  LHLD    RCTAD           ;ROWCOUNT TO HL
037B    19                      DAD     D               ;ADD TOP AND ROWCNT
037C    22DA87                  SHLD    LOC01           ;STORE LOC OF 1ST
                                                        ;CHAR IN ROW
037F    EB                      XCHG                    ;MOVE TO DE
0380    210000                  LXI     H,0             ;ZERO HL
0383    3AD287                  LDA     CCTAD           ;COLUMN CNT TO A
0386    6F                      MOV     L,A             ;MOVE TO L
0387    19                      DAD     D               ;LOC=TOP+ROWCNT+COLCNT
0388    22D887                  SHLD    LOCAD           ;STORE IN MEM
038B    3E87                    MVI     A,087H          ;87H TO A
038D    BC                      CMP     H               ;IS H 87H ?
038E    D29703                  JNC     NXTCM           ;NC=CONTINUE COMPARE
0391    CDDC03                  CALL    COMRT           ;COMPENSATE ROUTINE
0394    C3A303                  JMP     XSTAD           ;JUMP OVER
0397    C2A303          NXTCM:  JNZ     XSTAD           ;NE,END COMPARE
1
 8080 MACRO ASSEMBLER, VER 2.0   ERRORS = 0 PAGE 11

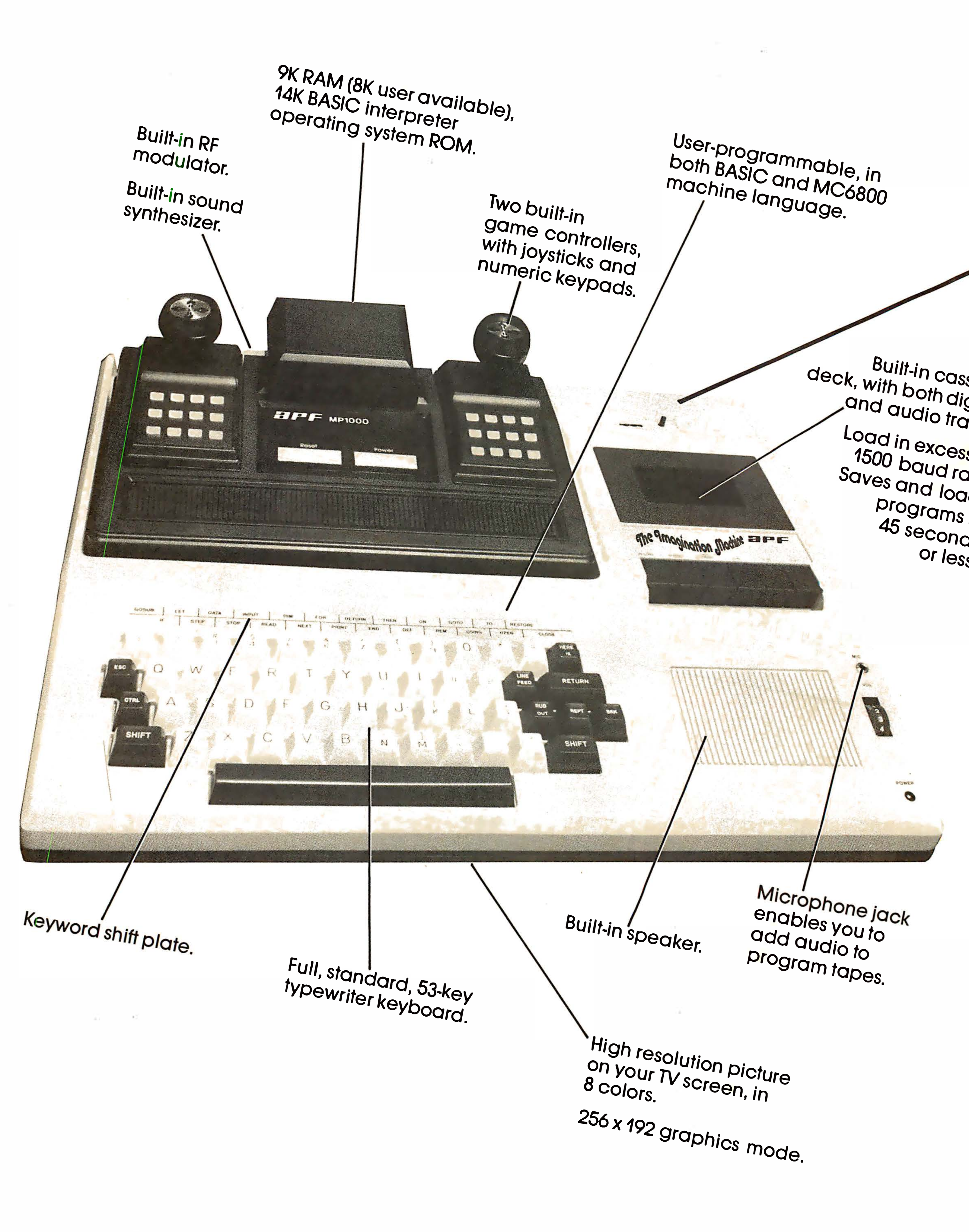

039A    3ECF                    MVI     A,0CFH          ;CFH TO A
039C    BD                      CMP     L               ;IS L=CFH
039D    D2A303                  JNC     XSTAD           ;NC=LOC<=87CFH
03A0    CDDC03                  CALL    COMRT           ;IF CARRY COMPENSATE
03A3    CDF103          XSTAD:  CALL    EORT            ;END OF ROW CHAR TEST
03A6    21E587                  LXI     H,USCHR         ;UART CHAR ADD TO HL
03A9    7E                      MOV     A,M             ;UART CHAR TO A
03AA    E63F                    ANI     03FH            ;MASK UPPER 2 BITS
03AC    2AD887                  LHLD    LOCAD           ;LOCATION TO HL
03AF    77                      MOV     M,A             ;MOV TO LOC IN DISP
03B0    C9                      RET
                        ;
                        ; SUBROUTINE DISA
                        ;
03B1    21D287          DISA:   LXI     H,CCTAD         ;COL CNT ADD TO HL
03B4    34                      INR     M               ;INC COL COUNT
03B5    CD3203                  CALL    WP75            ;LOAD CURSOR POS
03B8    C9                      RET
                        ;
                        ; SUBROUTINE DISB
                        ;
03B9    3E00            DISB:   MVI     A,0             ;ZERO A
03BB    32D287                  STA     CCTAD           ;ZERO COLUMN CNT
03BE    2AD387                  LHLD    RCTAD           ;ROWCOUNT TO HL
03C1    115000                  LXI     D,050H          ;80D TO DE
03C4    19                      DAD     D               ;ADD 80D TO ROWCOUNT
03C5    22D387                  SHLD    RCTAD           ;STORE IN MEM
03C8    21D587                  LXI     H,CURSY         ;CURSOR Y ADD TO HL
03CB    34                      INR     M               ;INC CURSOR Y
03CC    CD3203                  CALL    WP75            ;LOAD CURSOR POS
03CF    C9                      RET
                        ;
                        ; SUBROUTINE DISC
                        ;
03D0    3E00            DISC:   MVI     A,0             ;ZERO A
03D2    32D287                  STA     CCTAD           ;ZERO COLUMN CNT
03D5    CD3203                  CALL    WP75            ;LOAD CURSOR POS
03D8    CDFF03                  CALL    SCROL
03DB    C9                      RET
                        ;
                        ; ADDRESS COMPENSATION ROUTINE
                        ;
03DC    2AD887          COMRT:  LHLD    LOCAD           ;CHAR LOCATION
03DF    1130F8                  LXI     D,0F830H        ;COMP VALUE TO DE
03E2    19                      DAD     D               ;ADD TO LOCATION
03E3    22D887                  SHLD    LOCAD           ;STORE IN MEM
03E6    2ADA87                  LHLD    LOC01           ;LOC OF 1ST CHAR
03E9    1130F8                  LXI     D,0F830H        ;COMP VALUE TO DE
03EC    19                      DAD     D               ;ADD TO LOCATION
03ED    22DA87                  SHLD    LOC01           ;STORE IN MEM
03F0    C9                      RET
```

```
1
8080 MACRO ASSEMBLER, VER 2.0   ERRORS = 0 PAGE 12
                          ;
                          ; END OF ROW TEST ROUTINE
                          ;
03F1    2ADA87    EORT:   LHLD LOC01         ;LOC OF 1ST CHAR
03F4    7E                MOV  A,M           ;1ST CHAR TO A
03F5    FEF0              CPI  0F0H          ;END OF ROW CHAR ?
03F7    C0                RNZ                ;IF NOT EXIT
03F8    22E287            SHLD LOCBUF        ;STORE 1ST CHAR ADD
03FB    CD2604            CALL FILL          ;FILL ROW WITH SPACES
03FE    C9                RET
                          ;
                          ; SCROLL SUBROUTINE
                          ;
03FF    2AD687    SCROL:  LHLD TOPAD         ;TOP TO HL
0402    22E287            SHLD LOCBUF        ;STORE 1ST CHAR ADD
0405    CD2604            CALL FILL          ;FILL ROW WITH SPACES
0408    2AD687            LHLD TOPAD         ;TOP TO HL
040B    7D                MOV  A,L           ;LOW BYTE TO A
040C    FE80              CPI  080H          ;IS IT 80H ?
040E    C21E04            JNZ  DUCK          ;IF NOT CONTINUE
0411    7C                MOV  A,H           ;HIGH BYTE TO A
0412    FE87              CPI  087H          ;IS IT 87H ?
0414    C21E04            JNZ  DUCK          ;IF NOT CONTINUE
0417    210080            LXI  H,8000H       ;IF 8087 TOP=8000H
041A    22D687            SHLD TOPAD         ;STORE IN MEM
041D    C9                RET
041E    115000    DUCK:   LXI  D,050H        ;80D TO DE
0421    19                DAD  D             ;ADD 80D TO TOP
0422    22D687            SHLD TOPAD         ;STORE IN MEM
0425    C9                RET
                          ;
                          ; FILL SUBROUTINE
                          ;
0426    2AE287    FILL:   LHLD LOCBUF        ;1ST CHAR IN ROW
0429    115000            LXI  D,050H        ;LOAD 80D IN DE
042C    19                DAD  D             ;ADD 80D TO 1ST CHAR
042D    22DC87            SHLD LOC80         ;STORE IN MEM
0430    012020            LXI  B,2020H       ;SPACES IN BC
0433    210000            LXI  H,0           ;ZERO HL
0436    39                DAD  SP            ;SP TO HL
0437    EB                XCHG               ;SP TO DE
0438    2ADC87            LHLD LOC80         ;LOC OF LAST CHAR IN
                                             ;ROW TO HL
043B    F9                SPHL               ;LAST CHAR LOC IN SP
043C    C5                PUSH B             ;FILL LINE WITH SPACES
043D    C5                PUSH B
043E    C5                PUSH B
043F    C5                PUSH B
0440    C5                PUSH B
0441    C5                PUSH B
0442    C5                PUSH B
1
8080 MACRO ASSEMBLER, VER 2.0   ERRORS = 0 PAGE 13

0443    C5                PUSH B
0444    C5                PUSH B
0445    C5                PUSH B
0446    C5                PUSH B
0447    C5                PUSH B
0448    C5                PUSH B
0449    C5                PUSH B
044A    C5                PUSH B
044B    C5                PUSH B
044C    C5                PUSH B
044D    C5                PUSH B
044E    C5                PUSH B
044F    C5                PUSH B
0450    C5                PUSH B
0451    C5                PUSH B
0452    C5                PUSH B
0453    C5                PUSH B
0454    C5                PUSH B
0455    C5                PUSH B
0456    C5                PUSH B
0457    C5                PUSH B
0458    C5                PUSH B
0459    C5                PUSH B
045A    C5                PUSH B
045B    C5                PUSH B
045C    C5                PUSH B
045D    C5                PUSH B
045E    C5                PUSH B
045F    C5                PUSH B
0460    C5                PUSH B
0461    C5                PUSH B
0462    C5                PUSH B
0463    C5                PUSH B
0464    EB                XCHG               ;SP TO HL
0465    F9                SPHL               ;RESTORE STACK
0466    C9                RET
                          ;
                          ; 8275 INTERRUPT SERVICE
                          ; 8257 REINITIALIZATION
                          ;
0467    3E00      RT75:   MVI  A,MDC57       ;MODE CLEAR COMMAND
0469    D348              OUT  PMD57         ;OUT TO 8257
046B    2AD687            LHLD TOPAD         ;TOP TO HL
046E    7D                MOV  A,L           ;LOW BYTE TO A
046F    D344              OUT  PC2SA         ;CHAN 2 START ADDRESS
0471    7C                MOV  A,H           ;HIGH BYTE TO A
0472    D344              OUT  PC2SA         ;CHAN 2 START ADDRESS
0474    7D                MOV  A,L           ;LOW BYTE TO A
0475    2F                CMA                ;COMPLEMENT A
0476    6F                MOV  L,A           ;MOVE TO L
0477    7C                MOV  A,H           ;HIGH BYTE TO A
1
8080 MACRO ASSEMBLER, VER 2.0   ERRORS = 0 PAGE 14

0478    2F                CMA                ;COMPLEMENT A
0479    67                MOV  H,A           ;MOVE TO H
047A    23                INX  H             ;2'S COMP IN HL OF TOP
047B    11CF87            LXI  D,87CFH       ;87CFH TO DE
047E    19                DAD  D             ;ADD=87CFH-TOP
047F    110080            LXI  D,8000H       ;8000H TO DE
0482    19                DAD  D             ;ADD 8000H+87CFH-TOP
0483    7D                MOV  A,L           ;LOW BYTE TO A
0484    D345              OUT  PC2TC         ;OUT CHAN 2 TC TO 8257
0486    7C                MOV  A,H           ;HIGH BYTE TO A
0487    D345              OUT  PC2TC         ;OUT CHAN 2 TC TO 8257
0489    210080            LXI  H,8000H       ;8000H TO HL
048C    7D                MOV  A,L           ;LOW BYTE TO A
```

Listing 2 continued on page 142



9K RAM (8K user available), 14K BASIC interpreter operating system ROM.
Built-in RF modulator.
Built-in sound synthesizer.
User-programmable, in both BASIC and MC6800 machine language.
Two built-in game controllers, with joysticks and numeric keypads.
apf MP1000
Reset
Power
The Imagination Machine apf
ESC
CTRL
SHIFT
RETURN
SHIFT
Keyword shift plate.
Full, standard, 53-key typewriter keyboard.
Built-in speaker.
Microphone jack enables you to add audio to program tapes.
High resolution picture on your TV screen, in 8 colors.
256 x 192 graphics mode.

All that computer for $599.

The Imagination Machine, the personal computer from APF Electronics.

The Imagination Machine is more personal computer than you'd expect at $599.

The Imagination Machine is a superbly designed, expandable, user-programmable computer system... at $599.

No other personal computer on the market can touch it, at that price.

Read what it brings you:

First of all, The Imagination Machine has 9K RAM and 14K BASIC-IN-ROM. A full 53-key professional, typewriter keyboard. A high-resolution picture on your TV set, in eight colors. Fast loading (1500+ baud rate), built-in dual-track cassette deck, for APF's digitally recorded tape programs. Built-in sound synthesizer. And, even a built-in RF modulator, which is a $40 option on other computer systems.

All that, plus user-programmability.

We know sophisticated users aren't going to be satisfied forever using preprogrammed software. (Even though we offer a large library of educational, entertainment, home and business management programs.) So, we made The Imagination Machine user programmable, in both BASIC and MC6800 machine language. To simplify matters, we've just developed the first and only BASIC TUTOR course on cassette. With it, you can learn to program The Imagination Machine in BASIC, with hands-on training, right at the computer.

Some exceptional features.

The Imagination Machine has several unique features that can help you use your time at the computer more effectively.

For example, it stores programs and data on the same cassette tape. (With other computers, you have to read programs from one tape into the computer, remove the tape, put in another tape and store your data on the new tape.)

Another special feature is The Imagination Machine's unique keyword system, which simplifies BASIC programming. The machine has 24 different programs statements and commands printed at the top of the keyboard. You can enter these 24 into your program without retyping them every time you use them. Instead of typing out "PRINT," for example, you just press two keys and the word appears on the screen. The system helps prevent typing errors and can speed up entering programs.

A third feature is Timed Response Monitoring, which automatically adjusts the computer's pace and level to your own. It makes "tutoring programs," for instance, easier and more interesting to follow.

And then there are The Imagination Machine's three graphic display modes: 1. Alpha numerics, mixed with low-resolution graphics in as many as eight colors. 2. High resolution — up to eight colors — 128 x 192 display. 3. High resolution graphics — up to four colors — with 256 x 192 display.

And expandability.

A personal computer that can't grow along with your growing requirements soon becomes obsolete. So, we designed The Imagination Machine to be expandable. By adding APF's optional "Expansion Box" and interface cartridges, you can hook up any compatible floppy disk or printer, or an additional 8K RAM memory cartridge.

Full mini-floppy system $995.



For small business and professional use, you may require a full mini-floppy system. In that case, order APF's System II. It includes The Imagination Machine, the "Expansion Box," floppy disk interface and 72K-byte, mini-floppy disk drive. All for just $995! No one can come close to that price.

You can't beat our prices or our guarantee.

If you can find a better personal computer system for the money, let us know. In the meantime, we stand by our statement: There is no other personal computer on the market that offers so much for so little. And if you order now, we'll even include our $19.95 APF Technical Reference Manual, with complete schematics, absolutely free.

Order The Imagination Machine directly from APF Electronics, with the assurance that if you are not completely satisfied, you can return it within 30 days of purchase for a complete refund. To order, or to learn the name of the dealer nearest you, call TOLL FREE 1-800-223-1264. New York residents call 212-869-1960. MasterCard and VISA accepted.

Price list:

System I, The Imagination Machine.	$599.
System II, Mini-floppy System (Includes The Imagination Machine, BB-2, and Mini-floppy Disk Drive).	$995.
BB-1. Expansion Box with RS232 cartridge.	$199.95
BB-2. Expansion Box with floppy disk interface cartridge.	$199.95
8K RAM memory cartridge.	$ 99.95
RS232 cartridge.	$ 99.95
Floppy-disk interface cartridge.	$149.95
Mini-floppy Disk Drive.	$399.95

$599. Manufacturer's suggested retail price.



Listing 2 continued from page 139:

```
048D   D346             OUT   PC3SA         ;CHAN 3 START ADD TO 8257
048F   7C               MOV   A,H           ;HIGH BYTE TO A
0490   D346             OUT   PC3SA         ;CHAN 3 START ADD TO 8257
0492   21CF87           LXI   H,87CFH       ;87CFH TO HL
0495   7D               MOV   A,L           ;LOW BYTE TO A
0496   D347             OUT   PC3TC         ;CHAN 3 START ADDRESS
0498   7C               MOV   A,H           ;HIGH BYTE TO A
0499   D347             OUT   PC3TC         ;CHAN 3 START ADDRESS
049B   3E84             MVI   A,MDS57       ;MODE SET VAL TO A
049D   D348             OUT   PMD57         ;OUT MODE SET TO 8257
049F   C9               RET
                ;
                ; 8279 KEYBOARD POLLING ROUTINE
                ;
04A0   DB61     KPOLL:  IN    KCOM          ;INPUT FIFO STATUS
04A2   E607             ANI   007H          ;SAVE BITS 0-2
04A4   C8               RZ                  ;RETURN IF EMPTY
04A5   CDA904           CALL  XMIT          ;TRANSMIT CHARACTER
04A8   C9               RET
                ;
                ; CHARACTER TRANSMIT ROUTINE FOR 8251
                ;
04A9   DB60     XMIT:   IN    KDAT          ;INPUT FIFO CHAR
04AB   EEC0             XRI   0C0H          ;INVERT TOP 2 BITS
04AD   21E904           LXI   H,BSET3       ;LOAD BASE ADD TABLE 3
04B0   110000           LXI   D,0           ;ZERO DE
04B3   5F               MOV   E,A           ;MOVE CHAR TO DE
04B4   19               DAD   D             ;ADD BASE TO CHAR
04B5   DB01     USZ:    IN    CNCTL         ;INPUT UART STATUS
04B7   E601             ANI   001H          ;MASK TREADY BIT
04B9   CAB504           JZ    USZ           ;LOOP IF NOT READY
04BC   7E               MOV   A,M           ;LOAD CHAR FROM TABLE
04BD   D300             OUT   CNOUT         ;OUT CHAR TO UART
04BF   C9               RET
                ;
                ; DUMMY ROUTINE
                ;
04C0   C9       DUMY:   RET
1
 8080 MACRO ASSEMBLER, VER 2.0   ERRORS = 0 PAGE 15


                ;
                ; LOOKUP TABLES
                ;
04C1   C004     BSET1:  DW    DUMY
04C3   3501             DW    ESCA
04C5   5B01             DW    ESCB
04C7   7901             DW    ESCC
04C9   A901             DW    ESCD
04CB   2B02             DW    ESCE
04CD   C004             DW    DUMY
04CF   C004             DW    DUMY
04D1   E101             DW    ESCH
04D3   C004             DW    DUMY
04D5   5C02             DW    ESCJ
04D7   F301             DW    ESCK
04D9   C004             DW    DUMY
04DB   C004             DW    DUMY
04DD   C004             DW    DUMY
04DF   C004             DW    DUMY
04E1   FB02     BSET2:  DW    CTRLH
04E3   EF02             DW    CTRLJ
04E5   F202             DW    CTRLM
04E7   C004             DW    DUMY
                ;*************************************************
04E9   1B       BSET3:  DB    01BH          ;ESC
04EA   31               DB    031H          ;1
04EB   32               DB    032H          ;2
04EC   33               DB    033H          ;3
04ED   34               DB    034H          ;4
04EE   35               DB    035H          ;5
04EF   36               DB    036H          ;6
04F0   00               DB    0             ;NC
04F1   09               DB    009H          ;TAB
04F2   51               DB    051H          ;Q
04F3   57               DB    057H          ;W
04F4   45               DB    045H          ;E
04F5   52               DB    052H          ;R
04F6   54               DB    054H          ;T
04F7   59               DB    059H          ;Y
04F8   00               DB    0             ;NC
04F9   00               DB    0             ;NC
04FA   41               DB    041H          ;A
04FB   53               DB    053H          ;S
04FC   44               DB    044H          ;D
04FD   46               DB    046H          ;F
04FE   47               DB    047H          ;G
04FF   48               DB    048H          ;H
0500   00               DB    0             ;NC
0501   00               DB    0             ;L BLANK
0502   5A               DB    05AH          ;Z
0503   58               DB    058H          ;X
1
 8080 MACRO ASSEMBLER, VER 2.0   ERRORS = 0 PAGE 16


0504   43               DB    043H          ;C
0505   56               DB    056H          ;V
0506   42               DB    042H          ;B
0507   4E               DB    04EH          ;N
0508   20               DB    020H          ;SPACE
                ;*************************************************
0509   00               DB    0             ;R BLANK
050A   00               DB    0             ;NC
050B   00               DB    0             ;NC
050C   2F               DB    02FH          ;/
050D   2E               DB    02EH          ;.
050E   2C               DB    02CH          ;,
050F   4D               DB    04DH          ;M
0510   00               DB    0             ;NC
0511   0D               DB    00DH          ;CR
0512   7B               DB    07BH          ;L BRACE
0513   27               DB    027H          ;'
0514   3B               DB    03BH          ;;
0515   4C               DB    04CH          ;L
0516   4B               DB    04BH          ;K
0517   4A               DB    04AH          ;J
0518   00               DB    0             ;NC
0519   0A               DB    00AH          ;LF
051A   5C               DB    05CH          ;\
051B   5B               DB    05BH          ;L BRACKET
051C   50               DB    050H          ;P
```

Listing 2 continued on page 144

Listing 2 continued from page 142:

```
051D    4F              DB      04FH            ;O
051E    49              DB      049H            ;I
051F    55              DB      055H            ;U
0520    7F              DB      07FH            ;DEL
0521    5C              DB      05CH            ;
0522    3D              DB      03DH            ;=
0523    2D              DB      02DH            ;-
0524    30              DB      030H            ;0
0525    39              DB      039H            ;9
0526    38              DB      038H            ;8
0527    37              DB      037H            ;7
0528    08              DB      008H            ;BACKSPACE
                ;**************************************************
0529    1B              DB      01BH            ;ESC
052A    21              DB      021H            ;!
052B    40              DB      040H            ;AT SIGN
052C    23              DB      023H            ;#
052D    24              DB      024H            ;$
052E    25              DB      025H            ;%
052F    5E              DB      05EH            ;
0530    00              DB      0               ;NC
0531    09              DB      009H            ;TAB
0532    51              DB      051H            ;Q
0533    57              DB      057H            ;W
0534    45              DB      045H            ;E
1
 8080 MACRO ASSEMBLER, VER 2.0  ERRORS = 0 PAGE 17


0535    52              DB      052H            ;R
0536    54              DB      054H            ;T
0537    59              DB      059H            ;Y
0538    00              DB      0               ;NC
0539    00              DB      0               ;NC
053A    41              DB      041H            ;A
053B    53              DB      053H            ;S
053C    44              DB      044H            ;D
053D    46              DB      046H            ;F
053E    47              DB      047H            ;G
053F    48              DB      048H            ;H
0540    00              DB      0               ;NC
0541    00              DB      0               ;L BLANK
0542    5A              DB      05AH            ;Z
0543    58              DB      058H            ;X
0544    43              DB      043H            ;C
0545    56              DB      056H            ;V
0546    42              DB      042H            ;B
0547    4E              DB      04EH            ;N
0548    20              DB      020H            ;SPACE
                ;**************************************************
0549    00              DB      0               ;R BLANK
054A    00              DB      0               ;NC
054B    00              DB      0               ;NC
054C    3F              DB      03FH            ;?
054D    3E              DB      03EH            ;>
054E    3C              DB      03CH            ;<
054F    4D              DB      04DH            ;M
0550    00              DB      0               ;NC
0551    0D              DB      00DH            ;CR
0552    7D              DB      07DH            ;R BRACE
0553    22              DB      022H            ;"
0554    3A              DB      03AH            ;:
0555    4C              DB      04CH            ;L
0556    4B              DB      04BH            ;K
0557    4A              DB      04AH            ;J
0558    00              DB      0               ;NC
0559    0A              DB      00AH            ;LF
055A    7C              DB      07CH            ;VERT. BROKEN BAR
055B    5D              DB      05DH            ;R BRACKET
055C    50              DB      050H            ;P
055D    4F              DB      04FH            ;O
055E    49              DB      049H            ;I
055F    55              DB      055H            ;U
0560    7F              DB      07FH            ;DEL
0561    7E              DB      07EH            ;TILDE
0562    2B              DB      02BH            ;+
0563    5C              DB      05CH            ;
0564    29              DB      029H            ;)
0565    28              DB      028H            ;(
0566    2A              DB      02AH            ;*
1
 8080 MACRO ASSEMBLER, VER 2.0  ERRORS = 0 PAGE 18


0567    26              DB      026H            ;&
0568    08              DB      008H            ;BACKSPACE
                ;**************************************************
0569    1B              DB      01BH            ;ESC
056A    00              DB      0               ;NC
056B    00              DB      0
056C    00              DB      0
056D    00              DB      0
056E    00              DB      0
056F    00              DB      0
0570    00              DB      0               ;NC
0571    09              DB      009H            ;TAB
0572    11              DB      011H            ;CTRL Q
0573    17              DB      017H            ;CTRL W
0574    05              DB      005H            ;CTRL E
0575    12              DB      012H            ;CTRL R
0576    14              DB      014H            ;CTRL T
0577    19              DB      019H            ;CTRL Y
0578    00              DB      0               ;NC
0579    00              DB      0               ;NC
057A    01              DB      001H            ;CTRL A
057B    13              DB      013H            ;CTRL S
057C    04              DB      004H            ;CTRL D
057D    06              DB      006H            ;CTRL F
057E    07              DB      007H            ;CTRL G
057F    08              DB      008H            ;CTRL H
0580    00              DB      0               ;NC
0581    00              DB      0               ;L BLANK
0582    1A              DB      01AH            ;CTRL Z
0583    18              DB      018H            ;CTRL X
0584    03              DB      003H            ;CTRL C
0585    06              DB      006H            ;CTRL V
0586    02              DB      002H            ;CTRL B
0587    0E              DB      00EH            ;CTRL N
0588    20              DB      020H            ;SPACE
                ;**************************************************
0589    00              DB      0               ;R BLANK
058A    00              DB      0               ;NC
```

Listing 2 continued on page 146

COMPUTERS "R" US

MAIL ORDER DISCOUNTS

apple computer
Sales and Service

NEW! CALL FOR AVAILABILITY AND PRICE.

apple ///



$949 16K

32K $999

48K $1069

APPLE II OR APPLE II PLUS

APPLE COMPUTER PERIPHERALS

DISK II DRIVE & CONTROLLER card	485
DISK II DRIVE ONLY	425
GRAPHICS TABLET	655
SILENTYPE PRINTER w/Int. card	515
SSM AIO SERIAL/PARALLEL I/O kit.	125
SSM AIO Assembled & Tested	185
SYMTEC LIGHT PEN SYSTEM	215
SYMTEC SUPER SOUND GENERATOR	225
SVA 8 INCH DISK CONTROLLER CARD	335
VERSA WRITER DIGITIZER SYSTEM	215
VIDEX VIDEOTERM 80 COLUMNCARD	315
VIDEX VIDEOTERM w/graphics ROM	335
LOBO DISK DRIVE ONLY	385
LOBODRIVE w/controller card	465

APPLE COMPUTER INTERFACE CARDS

PARALLEL PRINTER Int. card	145
COMMUNICATIONCARD w/conn. cable	165
HI-SPEED SERIAL Int. care	145
LANGUAGE SYSTEM with PASCAL	425
CENTRONICS PRINTER Int. card	185
APPLESOFT II FIRMWARE card	149
INTEGER BASIC FIRMWARE card	149

MOUNTAIN COMPUTER ACCESSORIES
formerly Mountain Hardware

APPLE CLOCK/CALENDER card	225
SUPERTALKER SD200 SPEECH SYNTHISIZER SYSTEM	245
ROMPLUS w/keyboard filter	165
INTROL/X-10 BSR REMOTE CONTROL SYSTEM	245
INTROL/X-10 controller card only	165
ROMWRITER SYSTEM	155
MUSIC SYSTEM (18 voices/stereo)	465
A/D·D/A 16 CHANNELS	319
EXPANSION CHASSIS (8 slots)	555

APPLE ADD-ONS

CORVUS 10 MEGABYTE HARD DISK DRIVE SYSTEM w/pwr supply	4395
CORVUS CONSTELLATION	595
18K MEMORY UPGRADE KIT (TRS-80, APPLE II, SORCERER)	60
ABT NUMERIC INPUT KEYPAD (specify old or new kybrd)	115
ALF MUSIC SYNTHISIZER	235
BRIGHTPEN LIGHTPEN	32
GPIB IEEE-488(1978) Int.	259
ARITHMETIC PROCESSOR card	335
SPEECHLINK 2000 (84 Word Vocab.)	215
M&R SUP-R-MOD TV MODULATOR	25
M&R SUP-R-TERMINAL 60 column card	335
MICROSOFT Z-80 SOFTCARD SYSTEM w/CP/M	319
MICROWORKS DS-85 DIGISECTOR	339

APPLE II or APPLE II PLUS SOFTWARE

PASCAL with LANGUAGE SYSTEM	425
FORTRAN for use with LANGUAGE SYSTEM	185
CP/M for use with MICROSOFT Z-80 SOFTCARD (Incl.)	319
DOS3.3	49
THE CONTROLLER General Business System	519
THE CASHIER Retail Management & Inventory System	199
APPLEWRITER Word Processor	65
APPLEPOST MAILING LIST System	45
APPLEPLOT Graph & Plot System	60
DOW JONES PORTFOLIO EVALUATOR	45
CONTRIBUTED VOLUMES 1 THRU 5 w/Manuals	30
VISI-CALC by PERSONAL SOFTWARE	120
DESKTOP/PLAN by DESKTOP COMPUTERS	85
CCA DATA MANAGEMENT SYSTEM By PERSONAL SOFTWARE	85
APPLEBUG ASSEMBLER/DISASSEMBLER	75
APPLE DOS TOOLKIT	65

ATARI

16K $839

ATARI 800™
PERSONAL COMPUTER SYSTEM

ATARI ACCESSORIES

ATARI 400 COMPUTER	439
ATARI 820 PRINTER	489
ATARI 810 DISK DRIVE	575
ATARI 410 Program Recorder	69
ATARI 16K RAM MODULE	145
ASSEMBLER/EDITOR	45
STAR RAIDERS	40



16K $969

Exidy SORCERER COMPUTER

S-100 EXPANSION UNIT	375
WORD PROCESSING PAC	179
DEVELOPMENT PAC	89

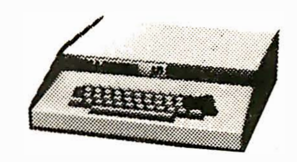
PRINTERS

ANADEX DP8000	775
ANADEX DP9500	1350
BASE 2	599
CENTRONICS 737	825
MPI 88-T	699
PAPER TIGER IDS-440 w/graphics	975
NEC SPINWRITER	2550
TRENDCOM 200	519
SILENTYPE w/Int	515

OHIO SCIENTIFIC
Challenger

OHIO SCIENTIFIC

C1P MOD 2	429
C4P	799
C4PMF (1 disk drive)	1589
AC-16P JOYSTICKS(2)	39
ATV RF TV MODULATOR	35



C4P

8K ROM BASIC
8K RAM EXPANDABLE TO 96K
32x64 UPPER & LOWER CASE
256x512 GRAPHICS POINTS
PROGRAMMABLE TONES
ANALOG INPUTS

C1P MOD II

8K ROM BASIC
8K RAM EXPANDABLE TO 32K
COLOR EXPANSION
48 LINE DISPLAY

LEEDEX MONITOR



VIDEO MONITORS

LEEDEX VIDEO 100	129
SANYO 9" B&W	155
SANYO 15" B&W	245
PANACOLOR 10" COLOR	329
ZENITH 13" COLOR	399

WIN AN APPLE DISK II DRIVE!!
GRAND OPENING GIVEAWAY....

HERE'S HOW TO ENTER THE DRAWING: Send your Name, Address, Telephone number, and the name of two friends that own Apple II's or are in the market for one. No purchase is necessary. Drawing will be held on December 1st 1980, all entries must be received before November 15th 1980. Names will be used for our 1981 catalog mailings.

FAST DELIVERY
LOW PRICES
COURTEOUS SERVICE
KNOWLEDGABLE STAFF
LARGE VARIETY





(714) 698-8088

CALL OR WRITE FOR OUR FREE 1981 CATALOG!

ORDERING INFORMATION: Phone Orders invited using VISA, MASTERCARD, AMERICAN EXPRESS, or bank wire transfers. VISA & MC credit card service charge of 2%, AE credit card service charge of 5%. Mail orders may send charge card number (include expiration date), cashiers check, money order or personal check (allow 14 business days to clear). Please include a telephone number with all orders. Foreign orders (excluding Military PO's) add 10% for shipping and all funds must be in US dollars. Shipping, handling and insurance in U.S. add 3%. California residents add 8% sales tax. Our low margins prohibit us to send COD or on account. All equipment subject to price change and availability. Equipment is new and complete with manufacturer warranty. We ship most orders within 2 days. Order desk hours are Monday thru Saturday 9-5 PST.

SEND ORDERS TO: COMPUTERS "R" US 8907 LA MESA BLVD., LA MESA, CALIF. 92041

Listing 2 continued from page 144:

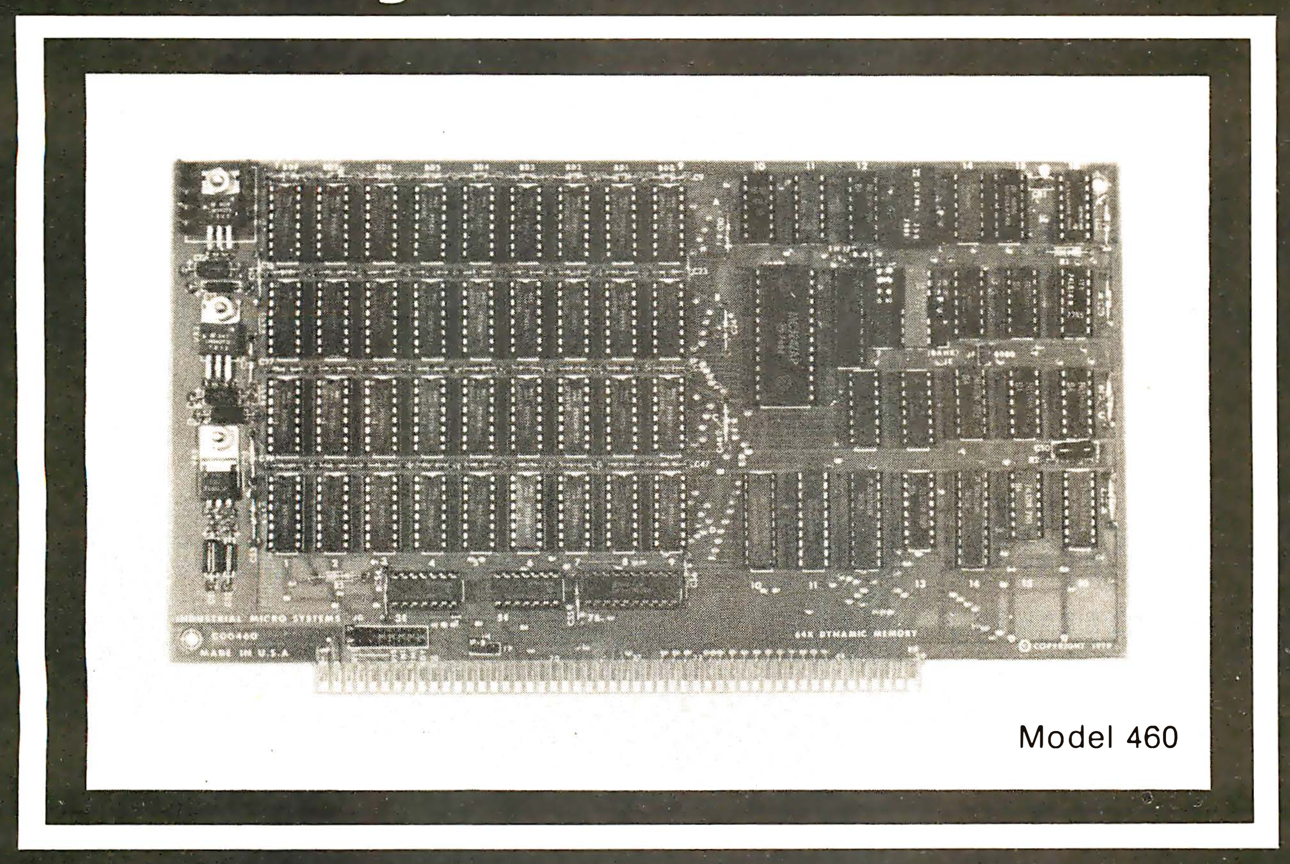
```
0588B  00              DB    0          ;NC
058C   00              DB    0          ;/
058D   00              DB    0          ;.
058E   00              DB    0          ;,
058F   0D              DB    00DH       ;CTRL M (CR)
0590   00              DB    0          ;NC
0591   0D              DB    00DH       ;CR
0592   00              DB    0          ;L BRACE
0593   00              DB    0          ;'
0594   00              DB    0          ;;
0595   0C              DB    00CH       ;CTRL L
0596   0B              DB    00BH       ;CTRL K
0597   0A              DB    00AH       ;CTRL J (LF)
1
 8080 MACRO ASSEMBLER, VER 2.0   ERRORS = 0 PAGE 19

0598   00              DB    0          ;NC
0599   0A              DB    00AH       ;LF
059A   1C              DB    01CH       ;CTRL
059B   1B              DB    01BH       ;CTRL L BRACKET
059C   10              DB    010H       ;CTRL P
059D   0F              DB    00FH       ;CTRL O
059E   09              DB    009H       ;CTRL I (TAB)
059F   15              DB    015H       ;CTRL U
05A0   7F              DB    07FH       ;DEL
05A1   1C              DB    01CH       ;CTRL
05A2   00              DB    0          ;=
05A3   00              DB    0          ;-
05A4   00              DB    0          ;0
05A5   00              DB    0          ;9
05A6   00              DB    0          ;8
05A7   00              DB    0          ;7
05A8   08              DB    008H       ;BACKSPACE
               ;***************************************************
05A9   0000            DW    0
05AB   0000            DW    0
05AD   0000            DW    0
05AF   0000            DW    0
05B1   0000            DW    0
05B3   0000            DW    0
05B5   0000            DW    0
05B7   0000            DW    0
05B9   0000            DW    0
05BB   0000            DW    0
05BD   0000            DW    0
05BF   0000            DW    0
05C1   0000            DW    0
05C3   0000            DW    0
05C5   0000            DW    0
05C7   0000            DW    0
05C9   0000            DW    0
05CB   0000            DW    0
05CD   0000            DW    0
05CF   0000            DW    0
05D1   0000            DW    0
05D3   0000            DW    0
05D5   0000            DW    0
05D7   0000            DW    0
05D9   0000            DW    0
05DB   0000            DW    0
05DD   0000            DW    0
05DF   0000            DW    0
05E1   0000            DW    0
05E3   0000            DW    0
05E5   0000            DW    0
05E7   0000            DW    0
               ;***************************************************
1
 8080 MACRO ASSEMBLER, VER 2.0   ERRORS = 0 PAGE 20

                       ; MINIMAL MONITOR
                       ;
05E9   3E40    SSS2:   MVI   A,040H
05EB   D301            OUT   1
05ED   3EFB            MVI   A,0FBH
05EF   D301            OUT   1
05F1   3E27            MVI   A,027H
05F3   D301            OUT   1
05F5   F3              DI
05F6   31FF87  START:  LXI   SP,87FFH
05F9   CDA306          CALL  CR
05FC   3E3F            MVI   A,'?'
05FE   CD8906          CALL  SOUT
0601   CD7706          CALL  SIN
0604   E67F            ANI   07FH
0606   FE4C            CPI   'L'
0608   CA2306          JZ    LOAD
060B   FE44            CPI   'D'
060D   CC3606          CZ    DUMP
0610   FE46            CPI   'F'
0612   CCF306          CZ    FIL
0615   FE4D            CPI   'M'
0617   CC1007          CZ    MOVE
061A   FE47            CPI   'G'
061C   C2F605          JNZ   START
                       ; 'GO' ROUTINE
                       ;
061F   CD6B06          CALL  INAD
0622   E9              PCHL
                       ; 'LOAD' ROUTINE
                       ;
0623   CD6B06  LOAD:   CALL  INAD
0626   CD5F06  T1:     CALL  OUTAD
0629   3E2D            MVI   A,'-'
062B   CD8906          CALL  SOUT
062E   CDD506          CALL  ZIN
0631   77              MOV   M,A
0632   23              INX   H
0633   C32606          JMP   T1
                       ; 'DUMP' ROUTINE
                       ;
0636   CD6B06  DUMP:   CALL  INAD
0639   EB              XCHG
063A   CD6B06          CALL  INAD
063D   EB              XCHG
063E   7D      B2:     MOV   A,L
063F   E60F            ANI   00FH
0641   C24706          JNZ   B1
0644   CD5F06          CALL  OUTAD
0647   3E20    B1:     MVI   A,' '
0649   CD8906          CALL  SOUT
```

Listing 2 continued on page 148

The Dynamic RAM...



...you've been waiting for.

QUALITY

For years you've looked to Industrial Micro Systems for quality S100 Static RAM boards. Now that same quality is available in the Model 460, our new Dynamic RAM board. The 460 combines the low power consumption and lower cost of dynamic RAM with Industrial Micro Systems high standard of quality and reliability.

PARITY

To ensure data reliability, the Model 460 is equipped with parity. The parity error line is shunt selectable to a number of interrupt lines for software control, or it can halt the CPU in a wait state. An LED on the board is lit when a parity error occurs.

MEMORY MANAGEMENT

The Model 460 is organized into 4 blocks of 16K bytes each. Each block is individually selectable under program control for memory management beyond 64K.

HIGH PERFORMANCE FEATURES

The Model 460 operates at 4MHZ with no wait states. It also utilizes on board "hidden refresh" circuitry for improved throughput.

Parity, memory management, Industrial Micro Systems quality...its all here.

You've waited long enough for a quality S100 Dynamic RAM board. See your Industrial Micro Systems Dealer today.

INDUSTRIAL MICRO SYSTEMS

Marketing Office
628 N. Eckhoff
Orange, CA 92668
(714) 978-6966

CONTACT FOR
DEALER LISTING

Manufacturing
2800 Lockheed Way
Carson City, NV 89701
(702) 883-7611

Listing 2 continued from page 146:

```
1
 8080 MACRO ASSEMBLER, VER 2.0   ERRORS = 0 PAGE 21

  064C   7E              MOV   A,M
  064D   CDE606          CALL  ZOUT
  0650   7C              MOV   A,H
  0651   BA              CMP   D
  0652   CA5906          JZ    X7
  0655   23      X8:     INX   H
  0656   C33E06          JMP   B2
  0659   7D      X7:     MOV   A,L
  065A   BB              CMP   E
  065B   C25506          JNZ   X8
  065E   C9              RET
                         ; OUTPUT HEX ADDRESS
                         ;
  065F   CDA306  OUTAD:  CALL  CR
  0662   7C              MOV   A,H
  0663   CDE606          CALL  ZOUT
  0666   7D              MOV   A,L
  0667   CDE606          CALL  ZOUT
  066A   C9              RET
                         ; INPUT HEX ADDRESS
                         ;
  066B   CDA306  INAD:   CALL  CR
  066E   CDD506          CALL  ZIN
  0671   67              MOV   H,A
  0672   CDD506          CALL  ZIN
  0675   6F              MOV L,A
  0676   C9              RET
                         ; INPUT CHAR FROM TTY
                         ;
  0677   DB01    SIN:    IN    1
  0679   E602            ANI   002H
  067B   CA7706          JZ    SIN
  067E   DB00            IN    0
  0680   FE1B            CPI   01BH
  0682   CAF605          JZ    START
  0685   CD8906          CALL  SOUT
  0688   C9              RET
                         ; OUTPUT CHAR TO TTY
                         ;
  0689   F5      SOUT:   PUSH  PSW
  068A   DB01            IN    1
  068C   E602            ANI   002H
  068E   CA9806          JZ    XY
  0691   DB00            IN    0
  0693   FE1B            CPI   01BH
  0695   CAF605          JZ    START
  0698   DB01    XY:     IN    1
  069A   E601            ANI   001H
  069C   CA9806          JZ    XY
  069F   F1              POP   PSW
  06A0   D300            OUT   0
1
 8080 MACRO ASSEMBLER, VER 2.0   ERRORS = 0 PAGE 22

  06A2   C9              RET
                         ; SENDS OUT CR/LF
                         ;
  06A3   3E0D    CR:     MVI   A,00DH
  06A5   CD8906          CALL  SOUT
  06A8   3E0A            MVI   A,00AH
  06AA   CD8906          CALL  SOUT
  06AD   C9              RET
                         ; INPUT CHAR, ADD ASCII BIAS
                         ; CHECKS FOR A HEX CHAR
  06AE   CD7706  XIN:    CALL  SIN
  06B1   FE30            CPI   030H
  06B3   DAF605          JC    START
  06B6   FE3A            CPI   03AH
  06B8   D8              RC
  06B9   FE41            CPI   041H
  06BB   DAF605          JC    START
  06BE   FE47            CPI   047H
  06C0   D2F605          JNC   START
  06C3   C609            ADI   009H
  06C5   C9              RET
                         ; OUTPUT CHAR, ADD ASCII BIAS
                         ;
  06C6   E60F    XOUT:   ANI   00FH
  06C8   C630            ADI   030H
  06CA   FE3A            CPI   03AH
  06CC   DAD106          JC    Z1
  06CF   C607            ADI   007H
  06D1   CD8906  Z1:     CALL  SOUT
  06D4   C9              RET
                         ; INPUT 2 ASCII CHAR
                         ; PACK IN REG A
  06D5   CDAE06  ZIN:    CALL  XIN
  06D8   0F              RRC
  06D9   0F              RRC
  06DA   0F              RRC
  06DB   0F              RRC
  06DC   E6F0            ANI   0F0H
  06DE   47              MOV   B,A
  06DF   CDAE06          CALL  XIN
  06E2   E60F            ANI   00FH
  06E4   80              ADD   B
  06E5   C9              RET
                         ; OUTPUT 2 ASCII CHAR
                         ; PACKED IN REG A
  06E6   F5      ZOUT:   PUSH  PSW
  06E7   0F              RRC
  06E8   0F              RRC
  06E9   0F              RRC
  06EA   0F              RRC
  06EB   CDC606          CALL  XOUT
1
 8080 MACRO ASSEMBLER, VER 2.0   ERRORS = 0 PAGE 23

  06EE   F1              POP   PSW
  06EF   CDC606          CALL  XOUT
  06F2   C9              RET
                         ; FILL MEMORY
                         ;
  06F3   CD6B06  FIL:    CALL  INAD
  06F6   EB              XCHG
  06F7   CD6B06          CALL  INAD
  06FA   EB              XCHG
  06FB   13              INX   D
  06FC   CDA306          CALL  CR
```

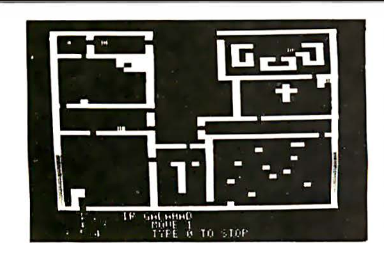
Listing 2 continued on page 150

Exciting, entertaining software for the Apple II and Apple II Plus*

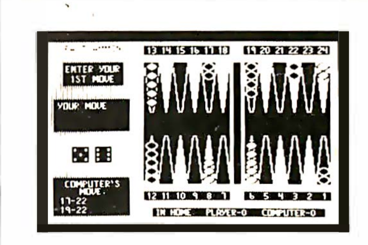
ASTEROIDS in space

If you liked "Invaders", you'll love ASTEROIDS IN SPACE by Bruce Wallace. Your space ship is traveling in the middle of a shower of asteroids. Blast the asteroids with lasers, but beware — big asteroids fragment into small asteroids! The Apple game paddles allow you to rotate your space ship, fire its laser gun, and give it thrust to propel it through endless space. From time to time you will encounter an alien space ship whose mission is to destroy you, so you'd better destroy it first! High resolution graphics and sound effects add to the arcade-like excitement that this program generates. Runs on any Apple II with at least 32K and one disk drive.

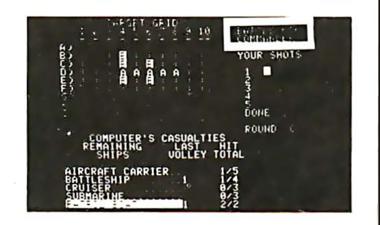
On diskette — **$19.95**



FRACAS™ by Stuart Smith. A fantastic adventure game like no other — up to eight players can participate in FRACAS at the same time. Journey in the land of FAROPH, searching for hidden treasure while warding off all sorts of unfriendly and dangerous creatures like the Ten Foot Spider and the Headless Horseman. You and your friends can compete with each other or you can join forces and gang up on the monsters. Your location is presented graphically and sound effects enliven the battles. Save your adventure on diskette or cassette and continue it at some other time. Requires at least 32K of RAM. Cassette: **$19.95** Diskette: **$24.95**



BATTLESHIP COMMANDER™ by Erik Kilk and Matthew Jew. A game of strategy. You and the computer each start out by positioning five ships of different sizes on a ten by ten grid. Then the shooting starts. Place your volleys skillfully — a combination of logic and luck are required to beat the computer. Cartoons show the ships sinking and announce the winner. Sound effects and flashing lights also add to the enjoyment of the game. Requires at least 32K of RAM.
Cassette: **$14.95** Diskette: **$19.95**



FASTGAMMON™ by Bob Christiansen. Sound, hi res color, and cartoons have helped maked this the most popular backgammon-playing game for the Apple II. But don't let these entertaining features fool you — FASTGAMMON plays serious backgammon. Requires at least 24K of RAM.
Cassette: **$19.95** Diskette: **$24.95**



QUALITY SOFTWARE

6660 Reseda Blvd., Suite 105, Reseda, CA 91335

WHERE TO GET IT: Call us at (213) 344-6599 for the name of the Quality Software dealer nearest you. If necessary, you may order directly from us. MasterCharge and Visa cardholders may place orders by telephone and we will deduct $1 from orders over $19 to compensate for phone charges. Or mail your order to the address above. California residents add 6% sales tax. SHIPPING CHARGES: Within North America orders must include $1.50 for first class shipping and handling. Outside North America the charge for airmail shipping and handling is $5.00 — payable in U.S. currency.

Listing 2 continued from page 148:

```
06FF     CDD506              CALL  ZIN
0702     47                  MOV   B,A
0703     70          XX:     MOV   M,B
0704     23                  INX   H
0705     7C                  MOV   A,H
0706     BA                  CMP   D
0707     C20307              JNZ   XX
070A     7D                  MOV   A,L
070B     BB                  CMP   E
070C     C20307              JNZ   XX
070F     C9                  RET
                             ; BLOCK MOVE IN MEM
                             ;
0710     1603        MOVE:   MVI   D,3
0712     CD6B06      BKM:    CALL  INAD
0715     E5                  PUSH  H
0716     15                  DCR   D
0717     C21207              JNZ   BKM
071A     E1                  POP   H
071B     C1                  POP   B
071C     03                  INX   B
071D     D1                  POP   D
071E     1A          BKZ:    LDAX  D
071F     77                  MOV   M,A
0720     13                  INX   D
0721     23                  INX   H
0722     7A                  MOV   A,D
0723     B8                  CMP   B
0724     C21E07              JNZ   BKZ
0727     7B                  MOV   A,E
0728     B9                  CMP   C
0729     C21E07              JNZ   BKZ
072C     C9                  RET
                     ;
                     ; VARIABLE STORAGE
                     ;
87D2                         ORG   87D2H
0001                 CCTAD:  DS    1
0002                 RCTAD:  DS    2
0001                 CURSY:  DS    1
1
 8080 MACRO ASSEMBLER, VER 2.0   ERRORS = 0 PAGE 24


0002                 TOPAD:  DS    2
0002                 LOCAD:  DS    2
0002                 LOC01:  DS    2
0002                 LOCB0:  DS    2
0002                 LOCXX:  DS    2
0002                 LOCPR:  DS    2
0002                 LOCBUF:DS     2
0001                 XFLG:   DS    1
0001                 USCHR:  DS    1
0002                 BOTAD:  DS    2
                     END
 NO PROGRAM ERRORS
1
 8080 MACRO ASSEMBLER, VER 2.0   ERRORS = 0 PAGE 25


                          SYMBOL TABLE

 * 01

 A       0007     AGGIE   00D2     ALPH    0142     ALPHA   0046
 B       0000     B1      0647     B2      063E     BETA    014C
 BILBO   0216     BKM     0712     BKZ     071E     BOTAD   87E6
 BSET1   04C1     BSET2   04E1     BSET3   04E9     C       0001
 CCTAD   87D2     CCTMA   01C4     CCTMB   01CD     CCTOA   0194
 CCTOB   019D     CHREC   00E1     CNCTL   0001     CNIN    0000
 CNOUT   0000     CNTRL   0123     COLLT   0322     COLRT   032A
 COMRT   03DC     COMRX   0220     COMRY   02E4     CR      06A3
 CRCOM   0051     CRDAT   0050     CRTGO   0040     CTA     0350
 CTB     0360     CTC     036D     CTRLH   02FB     CTRLJ   02EF
 CTRLM   02F2     CURSY   87D5     D       0002     DELTA   0172
 DIS1    0374     DISA    03B1     DISB    03B9     DISC    03D0
 DISPL   0341     DUCK    041E     DUMP    0636     DUMY    04C0
 E       0003     EORT    03F1     ESCA    0135     ESCB    015B
 ESCC    0179     ESCD    01A9     ESCE    022B     ESCH    01E1
 ESCJ    025C     ESCK    01F3     ESREC   010B     FIL     06F3
 FILL    0426     FIN     027F     FRODO   020A     FUN     02C2
 GAMMA   0168     GNOME   02A1     GZONK   02B3 *   H       0004
 INAD    066B     KCOM    0061     KDAT    0060     KPOLL   04A0
```

Listing 2 continued on page 152

Announcing the music card that turns you into a Rock Star.

Girls will climb over each other to kiss your feet.

Some companies will say anything to sell you a music card. One is "designed by leading experts". One's called the "Super Sound Generator". Another is "part of the excitement of owning a personal computer". Then there's the one with "flash & crash sound effects". And how about the one that "generates the sound of any musical instrument — real or imagined". Sure. Before you listen to their claims, listen to their music. That's where the real differences show up.

You can hear our music card at your local Apple dealer.

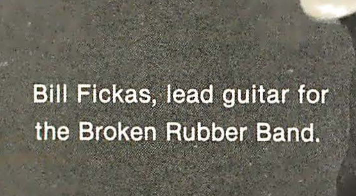
Or, just send us $1 and we'll send you a demo record of our 9 voice card.

When you listen to a music card, ask if the song you're hearing was programmed by a customer, or by experts at the company that made the card. Was it done with the software you'll get, or with special programming? Over half the songs on our demo record were entered by customers using the software supplied with the card – you can do it the same way. Our manual shows you how step by step.

The "Apple Music][" has 9 voices and is just $195*.

The "Apple Music Synthesizer" has 3 top-quality voices for just $265*.

See your local Apple dealer, or write for more details.



Bill Fickas, lead guitar for the Broken Rubber Band.

Quality computer music products since 1975.



ALF PRODUCTS
1448 Estes
Denver, CO 80215
(303) 234-0871

*Suggested U.S. price.

Listing 2 continued from page 150:

```
L       0005    LOAD    0623    LOADX   0235    LOC01   87DA
LOC80   87DC    LOCAD   87D8    LOCBU   87E2    LOCPR   87E0
LOCXX   87DE    LOOP    00BE    M       0006    MDC57   0000
MDS57   0084    MOVE    0710    NUP     02DA    NXT2    0055 *
NXTA    01B5    NXTCM   0397    NXTX    00ED    NXTY    00F9
NXTZ    0105    OUTAD   065F    PC2SA   0044    PC2TC   0045
PC3SA   0046    PC3TC   0047    PMD57   0048    PSW     0006
RCTAD   87D3    RDF51   00D9    ROWDN   0310    ROWUP   02FE
RT75    0467    SCROL   03FF    SIN     0677    SOUT    0689
SP      0006    SSS2    05E9    START   05F6    T1      0626
TOPAD   87D6    TROLL   0297    USCHR   87E5    USZ     04B5
VAR     0273    WIZAR   02CB    WP75    0332    X7      0659
X8      0655    XFLG    87E4    XIN     06AE    XMIT    04A9
XOUT    06C6    XSTAD   03A3    XX      0703    XY      0698
Z1      06D1    ZETA    0185    ZIN     06D5    ZOUT    06E6
```

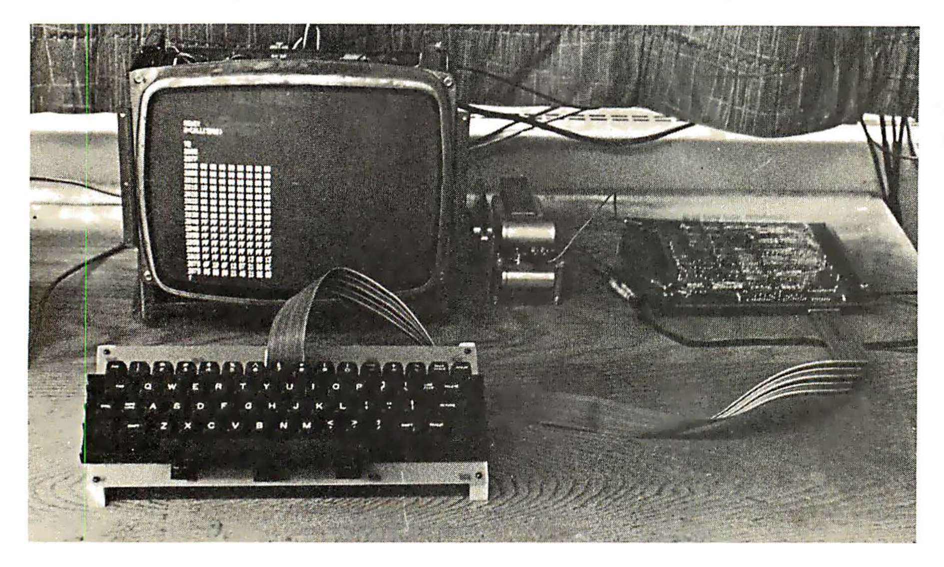


Photo 6: *The complete terminal system with keyboard, monitor, power supply, and main circuitry.*

Text continued from page 128:
but you cannot get the monitor operating with the checkout terminal, then most likely your problem is in the 2114 programmable memories, the decoder circuitry for the 2114s, or the 8212 buffers for the 2114s. Other problems could be caused by the temporary interface or data rates that differ.

Using the Monitor

After your built-in monitor is working, you can jump to it for use in debugging the remainder of the circuit. Opening the TRAP switch will cause the 8085 microprocessor to transfer control to the monitor. To return to the terminal-control software, the 8085 microprocessor is reset. To facilitate this, I have connected the BREAK switch on my keyboard to the 8085 $\overline{\text{RESET IN}}$ line (pin 36). This connection is also useful for resetting the video terminal just after it is turned on, or for easy clearing of the screen. One of the most useful functions of the system monitor is its ability to load into memory and run short programs that will read the status registers of the peripheral circuits to determine whether or not they are operating properly. This includes the 8251, 8257, 8275, and the 8279 integrated circuits.

The system monitor commands are as follows:

D (Dump): Type the letter D followed by two 4-digit hexadecimal numbers that represent addresses in the system. Memory contents between the two addresses will be printed on the checkout terminal in hexadecimal with 16 bytes on a line. The line will begin with the address of the first byte in that line. A dump can be aborted by pressing the ESC key.

F (Fill): To fill a block of memory with a specified value, type an F followed by two 4-digit hexadecimal addresses which are the inclusive locations in memory to be filled. Lastly, type the 2-digit hexadecimal number that the block of memory is to be filled with.

G (Go): Typing a G followed by a 4-digit hexadecimal address *will* transfer that address to the program counter, and program execution will continue from that location. After a short program has been loaded into memory, the Go command can transfer execution to this program.

L (Load): To load sequential memory locations with arbitrary values, type an L, followed by a 4-digit hexadecimal address. The system will prompt the user with sequential addresses, after which the user can type in the desired contents in the form of 2-digit hexadecimal numbers. You can exit from the load routine by typing any nonhexadecimal character.

M (Move): The Move command can write blocks of data from one memory location to another. After the M is typed, three 4-digit hexadecimal addresses must be typed in. The first two addresses enclose the block of data in memory to be moved, and the third address is the beginning location of the area where the block of data is to be written.

Any time a character other than D,F,G,L, or M is typed in response to the "?" prompt, the monitor will simply reissue the prompt character. When the appropriate response should be a hexadecimal character and another character is typed instead, the monitor will cancel the command and reissue the prompt character.

No carriage returns are necessary after typing in data to the system monitor. When the monitor has the correct amount of data it will execute the command.

Keyboard Assembly

I used the sixty-three-key unencoded keyboard offered by Jameco Electronics, 1021 Howard Ave, San Carlos CA 94070. The cost was $29.95. This is a good-quality keyboard for the price. Each pair of switch contacts protrudes from the bottom of the keyboard by about an eighth of an inch, making it necessary to mount the unit on a printed-circuit board. Because of the complexity of the switch matrix, a complete printed-circuit layout would have to

Text continued on page 156

YOU'RE A GENIUS FOR BUYING DATASTAR.™

But you don't have to be one to use it.

Now, from those wonderful folks that brought you WordStar,™ comes DataStar.™ A general purpose key to disc data entry software package you don't have to be a graduate from M.I.T. to operate.

DataStar makes life a breeze because DataStar makes data entry and verification a breeze.

It has two distinct phases. One allows you to actually design on the CRT the exact form you need. Just name the job. If it can be done on a CP/M* based microcomputer, then DataStar can do it. From handling inventory and billing to entering names in the office football pool. How's *that* for flexibility!

The other phase allows you to store and retrieve data. All kinds of data. Quickly and accurately. Which also allows you a chance for that second coffee break, you genius you.

And don't worry, DataStar makes sure that what you put into the system is right; because even a genius like you can sometimes make a mistake.

So go ahead. Let DataStar bring out the genius in you.

Simply call us at (415) 457-8990. After all, with over 300 dealers around the world, we've made *buying* DataStar as easy as *using* DataStar.



The world leader in microcomputer word processing.

MicroPro International Corporation 1299 4th Street, San Rafael, California 94901 Telex 340388
Dealer/Distributor/O. E. M. inquiries invited.

*Trademark of Digital Research Corporation

Prices and specifications subject to change without notice.

Listing 3: *A hexadecimal object dump of the video-terminal-control routine.*

```
C CRTBO
:03000000C34000FA
:03002400C3E90528
:1000400031FF8721FF7F2336207DFECFC246007C13
:10005000FE87C2460021000022D38722E28722D8F1
:100060008722DA8722DC8722DE8722E08721008050
:1000700022D68721808722E6873E0032D28732D57A
:100080008732E48732E5873E7BD3013E27D3013EAA
:100090003FD3613E00D3513E4FD3503E58D3503EE4
:1000A00089D3503E59D3503E80D3513E00D3503E69
:1000B00000D3503EE0D3513E23D351CD6704DB0142
:1000C000E602C4D200DB51E620C46704CDA004C31D
:1000D000BE00CDD900CDE100C9DB00E67F32E58767
:1000E000C93AE487E6FFCAED00CD0B01C93AE587BE
:1000F000E660CAF900CD4103C93AE587E610C205BA
:1001000001CD2301C921E4873601C93E0032E487CD
:100110003AE587E60F0721C1041100005F195E234D
:1001200056EBE93AE587E60621E1041100005F1984
:100130005E2356EBE92AD3877DFE00CA4201CDFE3D
:100140002C97CFE00CA4C01CDFE02C921800722F3
:10015000D3873E1832D587CD3203C92AD3877DFE97
:1001600080CA6801CD1003C97CFE07CA7201CD1098
:1001700003C9CD3203CDFF03C93AD287FE4FCA85EA
:1001800001CD2A03C92AD3877DFE80C294017CFE5B
:1001900007CA9D013E0032D287CD1003C93E00320E
:1001A000D287CD3203CDFF03C93AD287FE00CAB54C
:1001B00001CD2203C92AD3877DFE00C2C4017CFE83
:1001C00000CACD013E4F32D287CDFE02C921800741
:1001D00022D3873E4F32D2873E1832D587CD3203A5
:1001E000C921000022D3873E0032D28732D587CD85
:1001F0003203C92AD687EB2AD3871922DE873E87A6
:10020000BCD20A02CD2002C31602C216023ECFBDE6
:10021000D21602CD20022ADE8722E287CD2604C92B
:100220002ADE871130F81922DE87C93EF00619113F
:100230005000210080771905C2350221000022D329
:100240008721008022D68721808722E6873E0032E0
:10025000D28732D58732E487CD3203C92AD687EBDD
:100260002AD3871922E0873E87BCD27302CDE402ED
:10027000C37F02C27F023ECFBDD27F02CDE4022AFD
:10028000D6877DFE00C297027CFE80C29702218045
:100290008722E687C3A10211B0FF2AD6871922E67A
:1002A000873EF02AE087777DFE80C2CB027CFE8706
:1002B000C2CB02EB2AE6877DBBC2C2027CBAC2C2B5
:1002C00002C921008022E087C3A102EB2AE6877DD4
:1002D000BBC2DA027CBAC2DA02C92150001922E09C
:1002E00087C3A1022AE0871130F81922E087C9C329
:1002F0005B013E0032D287CD3203C9C3A9012AD3A4
:100300008711B0FF1922D38721D58735CD3203C994
:100310002AD3871150001922D38721D58734CD32B3
:1003200003C921D28735CD3203C921D28734CD32DA
:1003300003C93E80D3513AD287D3503AD587D350A0
:10034000C93AD287FE4FCA5003CD7403CDB103C959
:100350002AD3877DFE80CA6003CD7403CDB903C95B
:100360007CFE07CA6D03CD7403CDB903C9CD7403F8
:10037000CDD003C92AD687EB2AD3871922DA87EB97
:1003800021000003AD2876F1922D88873E87BCD297C6
:1003900003CDDC03C3A303C2A3033ECFBDD2A3039B
:1003A000CDDC03CDF10321E5877EE63F2AD88777B0
:1003B000C921D28734CD3203C93E0032D2872AD335
:1003C00087115000 1922D38721D58734CD3203C934
:1003D0003E0032D287CD3203CDFF03C92AD8871120
:1003E00030F81922D8872ADA871130F81922DA87EB
:1003F000C92ADA877EFEF0C022E287CD2604C92A08
:10040000D68722E287CD26042AD6877DFE80C21EAB
:1004100047CFE87C21E0421008022D687C91150A9
:100420000001922D687C92AE2871150001922DC87D9
:100430000120202100003 9EB2ADC87F9C5C5C59C
:10044000C5C5C5C5C5C5C5C5C5C5C5C5C5C5C55C
:10045000C5C5C5C5C5C5C5C5C5C5C5C5C5C5C54C
:10046000C5C5C5C5EBF9C93E00D3482AD6877DD39B
:10047000447CD3447D2F6F7C2F672311CF87191 1C4
:1004800000080197DD3457CD3452100807DD3467CF7
:10049000D34621CF877DD3477CD3473E84D348C9F9
:1004A000DB61E607C8CDA904C9DB60EEC021E90421
:1004B0001100005F19DB01E601CAB5047ED300C953
:1004C000C9C00435015B017901A9012B02C004C038
:1004D00004E101C0045C02F301C004C004C004C014
:1004E00004FB02EF02F202C0041B313233343536 12
:1004F000000095157455254590000415344464 7485A
:1005000000005A584356424E200000002F2E2C4D1A
:100510000000D7B273B4C4B4A000A5C5B504F495512
:100520007F5C3D2D30393837081B21402324255E60
:10053000000095157455254590000415344464 74819
:1005400000005A584356424E200000003F3E3C4DAA
:100550000000D7D223A4C4B4A000A7C5D504F4955B4
:100560007F7E2B5C29282A26081B00000000000043
:1005700000091117051214190000011304060708D9
:10058000000001A180306020E2000000000000000DF3
:1005900000000D0000000C0B0A000A1C1B100F0915AF
:1005A0007F1C000000000000008000000000000000A8
:1005B00000000000000000000000000000000000003B
:1005C00000000000000000000000000000000000002B
:1005D00000000000000000000000000000000000001B
:1005E0000000000000000000000003E40D3013EFBD3AD
:1005F00013E27D301F331FF87CDA3063E3FCD89CE
:1006000006CD7706E67FFE4CCA2306FE44CC3606AE
:10061000FE46CCF306FE4DCC1007FE47C2F605CDD4
:100620006B06E9CD6B06CD5F063E2DCD8906CDD597
:1006300067723C32606CD6B06EBCD6B06EB7DE676
:10064000FC24706CD5F063E20CD89067ECDE60669
:100650007CBACA590623C33E067DBBC25506C9CD26
:10066000A3067CCDE6067DCDE606C9CDA306CDD595
:10067000667CDD5066FC9DB01E602CA7706DB0047
:10068000FE1BCAF605CD8906C9F5DB01E602CA984C
:1006900006DB00FE1BCAF605DB01E601CA9806F17F
:1006A000D300C93E0DCD89063E0ACD8906C9CD7756
:1006B00006FE30DAF605FE3AD8FE41DAF605FE47C8
:1006C000D2F605C609C9E60FC630FE3ADAD106C62B
:1006D00007CD8906C9CDAE060F0F0F0FE6F047CD47
:1006E000AE06E60F80C9F50F0F0F0FCDC606F1CD90
:1006F000C606C9CD6B06EBCD6B06EB13CDA306CDBD
:10070000D5064770237CBAC203077DBBC20307C965
:100710001603CD6B06E515C21207E1C103D11A77A6
:0D07200013237AB8C21E077BB9C21E07C999
:0000000000
$
```



Centronics' new Model 737 means you get more than ever from a printer. Outstanding print quality. Fast, quiet operation. Ready to handle text processing, word processing, or electronic mail in addition to regular small business requirements. And it meets every business' prime requirement: low cost.

Outstanding Print Quality

Model 737 is the first small business printer to offer correspondence quality printing. Characters with true descenders as well as underlining. Proportional spacing, the ability to justify right margins and serif typeface makes the 737 ideal for text processing applications. Standard business data processing spacing makes it available for applications ranging from letters to aged accounts receivable reports. The steel platen assures crisp, clean print impression.

Unexpected Features

Leave it to Centronics to have some surprises in the new Model 737. You get the ability to print subscripts and superscripts (particularly important for chemical or mathematical applications). The field proven 700 Series printhead technology and fewer moving parts mean reliability that you wouldn't expect in a compact, low-cost printer.

And the 737 is quiet. An optional acoustic cover makes it ideal for office environments.

Pick Your Paper

Run letterhead paper for correspondence, roll paper for general information, or fan-fold paper for standard data processing (payroll, billing, inventory, etc.). You can, with the 3-way paper handling ability of the Model 737.

The Printer of the Future... Today

Never before has one printer offered such high quality, reliability, and applications flexibility at such low cost. (If you don't need the correspondence quality of the 737, our Model 730 delivers 100 c.p.s. at even greater savings.)

Why Wait?

The new Model 737 is now available for delivery. For more information: call (603) 883-0111, Centronics Data Computer Corporation, Hudson, New Hampshire 03051, or any of our 15 U.S.A. or 9 international sales offices.

All Centronics products are supported by the largest worldwide service network of any independent printer company. Always use genuine Centronics ribbons and accessories.

CENTRONICS® PRINTERS
...the advantage

Circle 97 on inquiry card.

Text continued from page 152:
be double sided and include plated-through holes. Since producing this type of printed-circuit board is beyond the capabilities of most amateur builders (including myself), I opted for a single-sided board with additional wire-wrap pins and connections to complete the wiring. The wiring diagram of the switch matrix is shown in figure 5, and an illustration of the printed-circuit layout is given in figure 6. A 24-pin wire-wrap socket was mounted at the top of the printed-circuit board and serves as a plug for the interconnecting cable. The cable is a 36-inch long DIP jumper with a 24-pin plug on each end. The Vector board also has a 24-pin wire-wrap socket to mate with the cable.

Install and Check Out the Video Circuitry

The remaining half of the components can be installed at this point. Check the video-dot-timing circuitry thoroughly to be sure that the correct frequencies are being generated at particular points in the circuit. After resetting the 8085 microprocessor, make sure that the 8224 is oscillating at 22.68 MHz. Pin 5 of IC15 (the 7474) should show the dot rate of 11.34 MHz as well as pin 2 of IC21 (the 74163) and pin 7 of IC22 (the 74166). You should measure a frequency of 1.620 MHz, which is the

Text continued on page 160

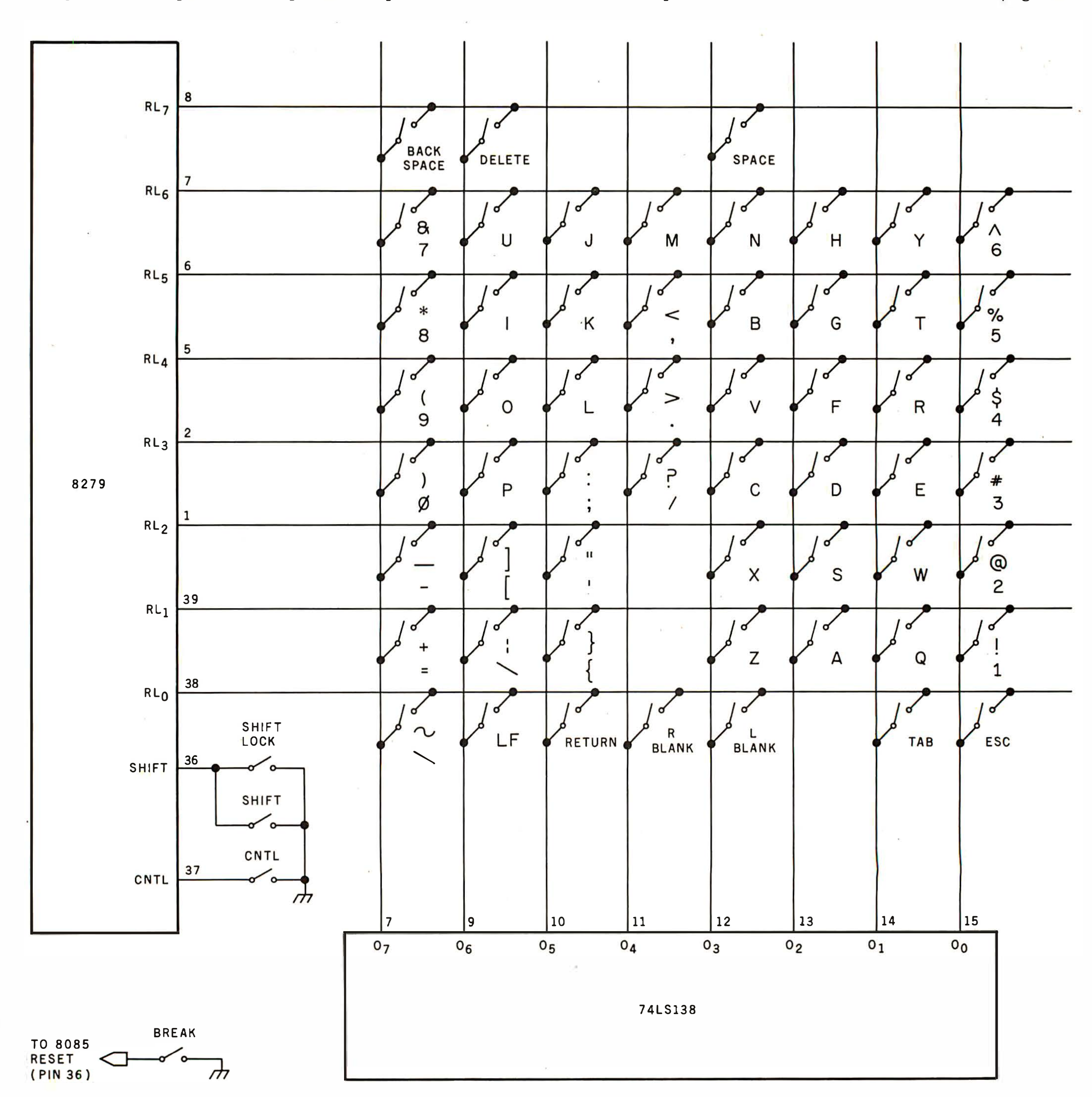


Figure 5: *Schematic diagram showing detail of the keyboard matrix. A sixty-three-key unencoded keyboard from Jameco Electronics was used. The BREAK key is connected to the RESET IN line of the 8085 processor.*

Apparat, Inc. introduces

NEWDOS/80

For the 80's — an enhanced NEWDOS for your TRS-80™ Model 1.

Apparat, Inc., announces the most powerful Disk Operating System for the TRS-80®. It has been designed for the sophisticated user and professional programmer who demands the ultimate in disk operating systems.

NEWDOS/80 is not meant to replace the present version of NEWDOS 2.1 which satisfies most users, but is a carefully planned upward enhancement, which significantly extends NEWDOS 2.1's capabilities. This new member to the Apparat NEWDOS' family is upward compatible with present NEWDOS 2.1 and is supplied on Diskette, complete with enhanced NEWDOS + utility programs and documentation. Some of the NEWDOS/80 features are:

- New BASIC commands that supports files with variable record lengths up to 4095 Bytes long.
- Mix or match disk drives. Supports any track count from 18 to 80. Use 35, 40 or 77 track 5" mini disks drives or 8" disk drives, or any combination.
- A security boot-up for BASIC or machine code application programs. User never sees "DOS READY" or ">READY" and is unable to "BREAK", clear screen, or issue any direct BASIC statement including "LIST".
- New editing commands that allow program lines to be deleted from one location and moved to another or to allow the duplication of a program line with the deletion of the original.
- Enhanced and improved RENUMBER that allows relocation of subroutines.
- Powerful chaining commands.
- Print Spooler.
- DFG function; simultaneous striking of the D, F and G keys will allow the user to enter a mini-DOS to perform some DOS commands without disturbing the resident program. (e.g. dir while in scripsit.)
- Upward compatible with NEWDOS 2.1 and TRSDOS 2.3.
- Includes machine language Superzap/80 and all Apparat 2.1 utilities.
- Enter debug any time by pressing 123 keys. Also allows disk I/O.
- Diskette "Purge" command.
- Specifiable system options (limited sysgen type commands).
- Increased directory capacity.
- Copy by file commands.

NEWDOS/80 with all of the NEWDOS + utility programs, many of which have been enhanced, is priced at just $149.00 and is available at most TRS-80 dealers.

As with 2.1, NEWDOS/80 relies on the TRSDOS and Disk Basic Reference Manual published by Radio Shack. NEWDOS/80 documentation supports its enhancements and upgrades only.



TO PURCHASE NEWDOS/80, COMPLETE AND MAIL TO:

Apparat, Inc.
4401 S. Tamarac Parkway
Denver, CO 80237
303/758-7275 303/741-1778

—OR—

Microcomputer Technology, Inc.
3304 W. MacArthur Blvd.
Santa Ana, CA 92704
714/979-9923

☐ Check ☐ Money Order ☐ Master Charge ☐ Visa

Card No. ________ Expiration Date ________

Colo. residents add 6.5% sales tax. Cal. residents add 6% sales tax.
Add $10.00 postage and handling.

Please rush ______ NEWDOS/80 @ $149 EACH TO:

Name ________

Address ________

City ______ State ______ Zip ______

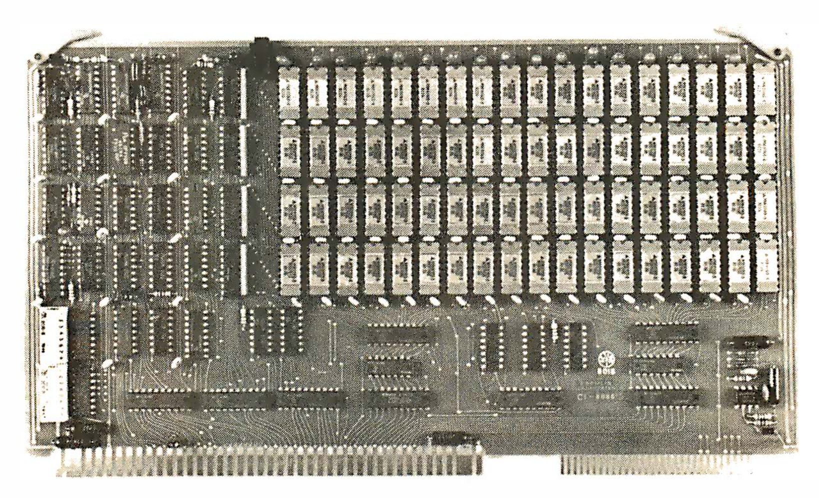
Phone ________

B0/1A

Circle 98 for MTI   Circle 99 for Apparat

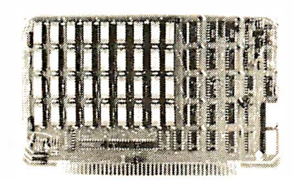
Figure 6: *The printed-circuit board layout for the keyboard matrix, shown here reduced to 82% of actual size. Use of a single-sided board makes some additional wire-wrap connections necessary.*

CHRISLIN YEARS AHEAD IN MEMORY DESIGN

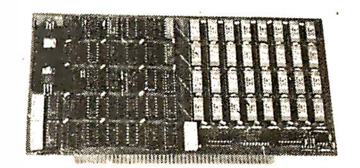


WE'VE DONE IT AGAIN — State of the Art Multibus® Memory Design. First to offer up to 512K on one board, and CHRISLIN again brings pricing sanity to the memory market. Why pay over $2000 for our competitor's 64K x 8 memory board when we will give you the CI-8086 128K x 9 memory for just $1500 or better yet, the CI-8086 512K x 9 memory module for $4700.

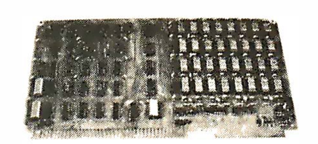
Up to 512K bytes in a single option slot. Available in 64K, 96K, 128K, 256K, or 512K configurations. On board parity generator checker, for both 8 bit or 16 bit systems. Off shelf deliveries.



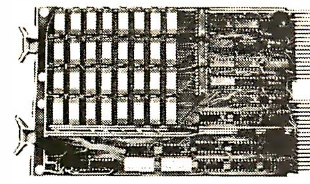
CI-6800-2 — 16KB to 64KB. Plugs directly into Motorola's EXORciser I or II. Hidden refresh up to 1.5 Mhz. Cycle stealing at 2 Mhz. Addressable in 4K increments with respect to VXA or VUA. On board parity. **64K x 9 $995.00.**



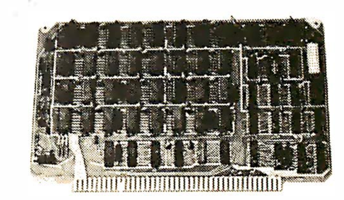
CI-S100 — 16KB to 64KB. Transparent hidden refresh. No wait states at 4 Mhz. Compatible with Alpha Micro and all Major 8080, 8085 and Z80 Based S100 Systems. Expandable to 512K bytes thru Bank Selections. **64K x 8 $750.00.**



CI-8080 — 16KB to 64KB on a single board. Plugs directly into MDS 800 and SBC 80/10. Addressable in 4K increments up to 64K. **16KB $390.00. 64KB $750.00.**



CI-1103 — 16KB to 256KB on a single dual height board. Plugs directly into LSI 11/2, H11 or LSI 11/23. Addressable in 2K word increments up to 256KB. **8K x 16 $390.00. 32K x 16 $750.00. 128K x 18 $2880.00.**



CI-6800 — 16KB to 64KB on a single board. On board hidden refresh. Plugs directly into EXORciser I and compatible with Rockwell's System 65. Addressible in 4K increments up to 64K. **16K x 8 $390.00. 64K x 8 $750.00.**

Tested and burned in. Full year warranty.

DON'T ASK WHY WE CHARGE SO LITTLE, ASK WHY THEY CHARGE SO MUCH.



Chrislin Industries, Inc.

Computer Products Division

31352 Via Colinas • Westlake Village, CA 91362 • 213-991-2254

Text continued from page 156:
character clock rate, on pins 6 and 8 of IC14 (the 7410), pin 12 of IC21 (the 74163), on pin 9 of IC23 thru IC27 (all five 74175s), pin 1 of IC21 (the 74163), pin 15 of IC22 (the 74166), and pin 30 of IC9 (the 8275). Pin 7 of the 8275 should measure 16,200 Hz, the horizontal line frequency, and pin 8 should be at 60 Hz, the frame frequency. Do not proceed until you can measure all of these frequencies correctly. If your display shows something quite distorted, torn, or scrambled, it is probably a problem in the video timing. An incorrect horizontal or vertical sync frequency can greatly disrupt a display.

Final Checkout

At this point, your terminal should be working. If it is not, double-check the following:

- On opening the TRAP switch, does the 8085 microprocessor branch to the monitor program and issue a carriage return, line feed, and question mark from the 8251?
- Are all of the frequencies listed above for the video timing correct in your circuit?
- Check the output of pin 35 of the 8275. This is the video-suppression (VSP) output which is active high during horizontal and vertical retrace at the top and bottom rows of every character, and in certain other cases involving end-of-row or end-of-series codes. Video suppression is also turned on if a direct-memory-access underrun occurs. If video-suppression is producing a logical 1 and has no activity on it, a direct-memory-access underrun is most likely your problem. This means that the software is not reinitializing the 8257 at the end of each video frame. The video-suppression line should show a frequency of 12 kHz on it. Pin 37 of the 8275 (the light-enable output) will have a frequency varying from 28 to 32 Hz.
- After the 8085 microprocessor has been reset and before data is sent to the video terminal, IC18 (the 74LS138 peripheral decoder) should be putting out pulses at constant rates. Pins 9, 10, and 15 should show a frequency of about 23 kHz, and pin 11 should show 600 Hz.
- The address-enable line on the 8257 (pin 9) should show a frequency of 1.5 kHz, and the address strobe (pin 8) should be 135 kHz. Again, these frequencies should be measured by a counter using a full 1-second gate time, since the duty cycles of pulses of these lines are not constant. This is especially true of the address-strobe output of the 8257.

Using a frequency counter and an oscilloscope to check for the correct activity on the various pins of integrated circuits is an effective method of troubleshooting your circuit. It is possible that a single wiring mistake is your only problem. Using an ohmmeter as a continuity tester and checking every connection is often worth the effort. I turn the circuit board over and put the ohmmeter probes on the pins of the integrated circuits themselves. This also serves to check for a bad socket connection. Draw over the connecting lines on your progress-checking schematic with a different colored pen as you make each check.

Possible Additions

Some readers may wish to make further modifications to my design. Here are some possibilities:

- Lowercase letters could be added fairly easily if the 7 by 10 format for each character is retained. The +5 V 2513 character generator is also available with a lowercase set of letters. The second character generator could be added by using the full 7-bit ASCII code in memory. Only six bits are stored in memory in this design. The most significant bit could be used to select which character generator would be enabled. The character-handling routine in the terminal control software would also have to be modified. If a larger format for characters was desired (eg: that used by the Motorola 6571 character generator), the entire dot timing would have to be changed, as well as the initialization of the 8275 in the software.
- The 8275 Video Display Controller has provisions for light-pen detection. Very little hardware would be needed to add this feature; only a small switch and a small light-sensor circuit using a phototransistor. When the raster sweep reaches the light sensor, it presents a signal to the light pen (LPEN) input, and the row and character positions are stored in a pair of registers in the 8275. These registers can be read on command. Modification of the control software would be necessary to read the registers and act upon their contents.
- Character- and field-attribute codes can also be handled by the 8275. Character-attribute codes are used to generate graphics symbols without the use of the character generator. These symbols can also be programmed to blink or be individually highlighted. Field attributes are codes that affect the characteristics of a field of characters. These characteristics are blink, highlight, reverse video, underline, and two general-purpose outputs that can be user defined. The Intel *Peripheral Design Handbook* gives details on implementing these features in both hardware and software.

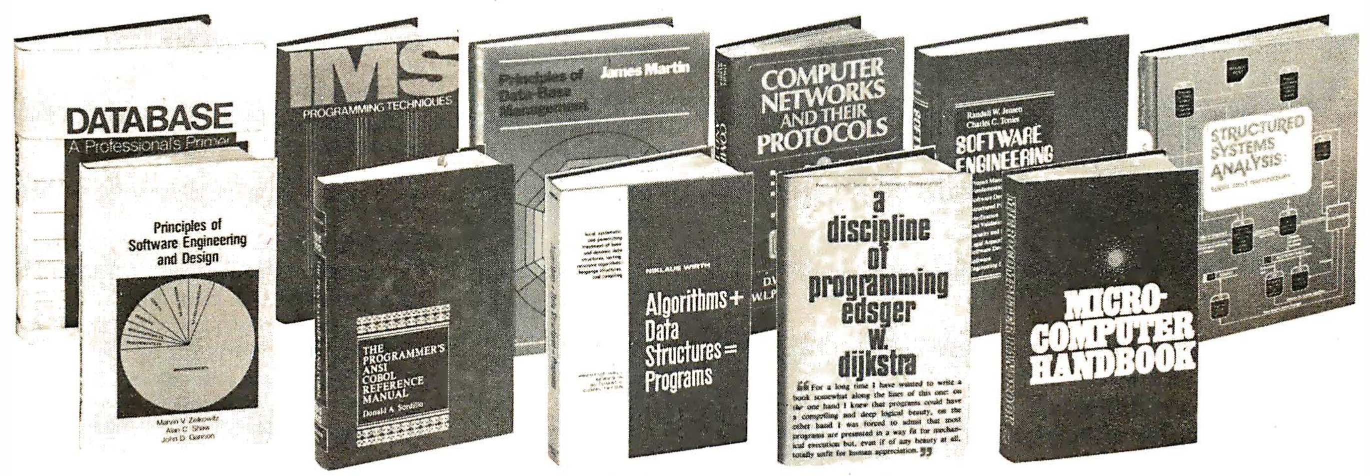
Conclusion

This terminal is not a suitable project for a beginner or for those who are inexperienced in microprocessor hardware. Time and patience will be indispensable in completing this project. I spent about three months assembling the parts and building the circuit. A month of this time involved debugging both hardware and software, due to the many changes I made in the original Intel design.

I would appreciate hearing from those readers who complete this project. Descriptions of any modifications made would also be welcome. ■

Discover

the most organized (and inexpensive) way to keep up with what's new in computer techniques and management—



The Library of Computer and Information Sciences

(Publishers' Prices shown)

41625. DATABASE: A PROFESSIONAL'S PRIMER. *David Kroenke.* Covers every aspect of data base concepts, systems and applications. $24.95

41785. DEBUGGING SYSTEM 360/370 PROGRAMS USING OS AND VS STORAGE DUMPS. *D. H. Rindfleisch.* Guide to storage dump debugging. Illustrations, examples, sample dumps. $19.95

42303. A DISCIPLINE OF PROGRAMMING. *Edsger W. Dijkstra.* New programming tools to solve problems that range from the everyday to the complex. $21.95

80837. STRUCTURED SYSTEMS ANALYSIS: Tools and Techniques. *Gane and Sarson.* $19.50

51955. A GUIDE TO THE SUCCESSFUL MANAGEMENT OF COMPUTER PROJECTS. *Hamish Donaldson.* $24.95

81845. SYSTEM/370 JOB CONTROL LANGUAGE. *Gary DeWard Brown.* Includes descriptions of hardware devices and access methods and reference to many useful JCL features. *Softcover.* $13.50

39995-2. COMPUTER NETWORKS AND THEIR PROTOCOLS. *D.W. Davies et al.* Latest technology in routing, pocket switching and flow control. *Counts as 2 of your 3 books.* $43.95

54455. IMS PROGRAMMING TECHNIQUES: A Guide to Using DL/1. *Kapp and Leben.* Specific techniques to write application programs in ANS COBOL, PL/1, or Assembler Language in an IMS DL/1 data base environment. $17.95

60385. MANAGING THE SYSTEMS DEVELOPMENT PROCESS. *Charles L. Biggs, et al.* $24.95

62620. MICROCOMPUTER HANDBOOK. *Charles J. Sippl.* Detailed reference to the technology and applications of microprocessors. $19.95

70110. PRINCIPLES OF DATA-BASE MANAGEMENT. *James Martin.* Covers data structures, security, file storage, real-time vs. non-real time, more. $19.95

70725. THE PROGRAMMER'S ANSI COBOL REFERENCE MANUAL. *Donald A. Sordillo.* $22.50

79150-2. SOFTWARE ENGINEERING. *Jensen & Tonies. Counts as 2 of your 3 books.* $27.50

79167. SOFTWARE RELIABILITY GUIDEBOOK. *Robert L. Glass.* Spells out all the technological and management techniques. $18.95

42053-2. DESIGNING A DISTRIBUTED PROCESSING SYSTEM. *Hamish Donaldson.* Casebook on how to manage projects successfully and a technical reference for the design problems that are peculiar to distributed processing. *Counts as 2 of your 3 books.* $34.95

Take any 3 books for only $1.00 each (values to $74.95)

If you will join now for a trial period and agree to take 3 more books—at handsome discounts—over the next 12 months

40135-2. A CONCISE DICTIONARY OF PHYSICS. *J. Thewlis.* More than 7,000 definitions. *Counts as 2 of your 3 books.* $50.00

42498. DOCUMENTATION STANDARDS AND PROCEDURES FOR ON-LINE SYSTEMS. *Edited by Martin L. Rubin.* A valuable guide to everything from user request documents to man/machine dialogue module for easier integration into existing company standards. $21.95

35450-2. AUTOMATIC DATA PROCESSING HANDBOOK. *The Diebold Group.* Auxiliary memory, peripherals, systems design, consultant services, software packages. *Counts as 2 of your 3 books.* $38.95

70230. PRINCIPLES OF SOFTWARE ENGINEERING AND DESIGN. *Marvin V. Zelkowitz, et al.* $21.95

40065-2. COMPUTER STORAGE SYSTEMS AND TECHNOLOGY. *Richard Matick. Counts as 2 of your 3 books.* $29.95

80150. STANDARDIZED DEVELOPMENT OF COMPUTER SOFTWARE. *Robert C. Tausworthe.* How to incorporate principles and techniques of structured programming in the development of large-scale systems. $19.95

80155. STANDARDIZED DEVELOPMENT OF COMPUTER SOFTWARE, PART II. *Robert C. Tausworthe.* A detailed set of rules for software implementation. Contains extensive appendices. $21.95

32485. ALGORITHMS + DATA STRUCTURES = PROGRAMS. *Niklaus Wirth.* A classic work on structured programming. $20.95

39890-2. COMPUTER DATA-BASE ORGANIZATION. *James Martin.* An invaluable planning tool having over 200 diagrams. *Counts as 2 of your 3 books.* $26.50

85725. UTILIZING SYSTEM 360/370 OS AND VS JOB CONTROL LANGUAGE AND UTILITY PROGRAMS. *Daniel H. Rindfleisch.* Practical guide to every feature of JCL and system utilities. $21.95

49600. THE FUTURE WITH MICROELECTRONICS. *Barron and Curnow.* Shows how future developments will transform every area of society from the factory to the home. $17.50

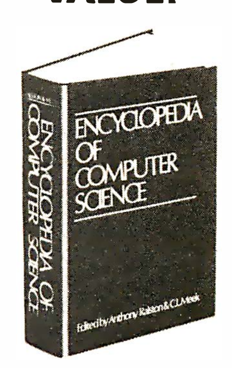
79155. SOFTWARE INTERPRETERS FOR MICROCOMPUTERS. *Thomas C. McIntire.* $18.95

50045-2. GAME THEORY: Mathematical Models of Conflict. *A. J. Jones.* Numerous diagrams, examples. *Counts as 2 of your 3 books.* $45.00

50551. GRANTS: How to Find Out About Them and What to Do Next. *Virginia P. White.* $19.50

39746-2. COMPANION TO CONCRETE MATHEMATICS. VOLUMES I AND II. *Z. A. Melzak.* Mathematical techniques and various applications. *The set counts as 2 of your 3 books.* $46.45

—EXTRAORDINARY— VALUE!



44900-3. THE ENCYCLOPEDIA OF COMPUTER SCIENCE. Monumental 1550-page volume offers accurate information on essential topics ranging from theory and applications to programming and Boolean algebra. *Counts as 3 of your 3 books.* $60.00

If the reply card has been removed, please write to **The Library of Computer and Information Sciences Dept 7-AD5, Riverside, N.J. 08075** to obtain membership information and application

The Age of Affordable Pers



In 1978 Ohio Scientific introduced a revolutionary new low cost computer — the Superboard II. This computer provides all important personal computer features on a single board at a cost of under $300. The Superboard II received rave reviews by microcomputer experts such as:

"We can heartily recommend the Superboard II computer system for the beginner who wants to get into microcomputers with a minimum of cost. Moreover, this is a 'real' computer with full expandability."
POPULAR ELECTRONICS MARCH, 1979

"The Superboard II weighs in at $279 and provides a remarkable amount of computing for this incredible price."
KILOBAUD MICROCOMPUTING FEBRUARY, 1979

"The Superboard II and its fully dressed companion the Challenger 1P series incorporate all the fundamental necessities of a personal computer at a very attractive price. With the expansion capabilities provided, this series becomes a very formidable competitor in the home computer area."
INTERFACE AGE APRIL, 1979

"The graphics available permit some really dramatic effects and are relatively simple to program . . . The fact that the system can be easily expanded to include a floppy means that while you are starting out with a low-cost minimal system, you don't have to throw it away when you are ready to go on to more complex computer functions. At $279, Superboard II is a tough act to follow."
RADIO ELECTRONICS JUNE, 1979

"The Superboard is an excellent choice for the personal computer enthusiast on a budget."
BYTE MAY, 1979

Since the introduction of Superboard II, the cost of personal computers has actually gone up with new models by major manufacturers ranging from $1000 to well over $4000 due to the general cost of inflation and the increasing functionality included in these computers. Today Cleveland Consumer Computers is offering you the original Superboard II at its original price of just $279. In today's economy this is by far the best buy in personal computing ever!

The Superboard II can entertain your whole family with spectacular video games and cartoons, made possible by its ultra high resolution graphics and super fast BASIC. It can help you with your personal finances and budget planning, made possible by its decimal arithmetic ability and cassette data storage capabilities. It can assist you in school or industry as an ultra powerful scientific calculator, made possible by its advanced scientific math functions and built-in "immediate" mode which allows complex problem solving without programming! This computer can actually entertain your children while it educates them in topics ranging from naming the Presidents of the United States to tutoring trigonometry — all possible by its fast extended BASIC, graphics and data storage ability.

The machine can be economically expanded to assist in your business, remotely control your home, communicate with other computers and perform many other tasks via the broadest line of expansion accessories in the microcomputer industry.

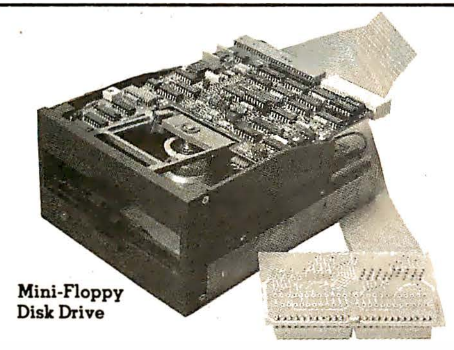
This machine is super easy to use because it communicates naturally in BASIC, an English-like programming language. So you can easily instruct it or program it to do whatever you want, but you don't have to. You don't because it comes with a complete software library on cassette including programs for each application stated above. Ohio Scientific also offers you hundreds of inexpensive programs on ready-to-run cassettes. Program it yourself or just enjoy it; the choice is yours.

The Superboard II comes fully assembled and tested. It requires +5V at 3 Amps and a video monitor or TV with RF converter to be up and running. $279.00

Standard Features:

- Uses the ultra powerful 6502 Microprocessor.
- 8K Microsoft BASIC-in-ROM. Full feature BASIC runs faster than currently available personal computers and all 8080 based business computers.
- 4K static RAM on board expandable to 8K.
- Full 53-key keyboard with upper/lower case and user programmability.
- Kansas City standard audio cassette interface for high reliability.
- Full machine code monitor and I/O utilities in ROM.

onal Computing is Still Here.



Mini-Floppy Disk Drive

Direct access video display has 1K of dedicated memory (besides 4K user memory), features upper case, lower case, graphics and gaming characters for an effective screen resolution of up to 256 x 256 points. Normal TV's with overscan display about 24 rows of 24 characters without overscan up to 30 x 30 characters.

Optional Extras:

- Available 610 expander board features up to 24K static RAM (additional), dual mini-floppy interface, and an OSI 48 line expansion interface.
- Assembler/Editor and Extended Machine Code monitor available.
- 630 I/O Expander. RGB color and NTSC composite color outputs with up to 16 colors, Dual 8-axis joystick interface, AC remote control interface which mates with AC-12P, home security interface which mates with the AC-17P, 16-line parallel I/O interface, 16-pin I/O bus interface which allows the connection of parallel I/O lines or high speed analog I/O module, or a PROM blaster or solderless interface prototyping board, programmable sound generator and program selectable modem and high speed printer ports, and more.

Freight Policies All orders of $100 or more are shipped freight prepaid. Orders of less than $100 please add $4.00 to cover shipping costs. Ohio Residents add 5.5% Sales Tax.

Guaranteed Shipment Cleveland Consumer Computers & Components guarantees shipment of computer systems within 48 hours upon receipt of your order. **Our failure to ship within 48 hours entitles you to $35 of software, FREE.**



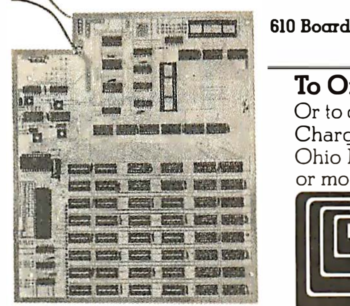


Hours:
Call Monday thru Friday
8:00 AM to 5:00 PM E.D.T.

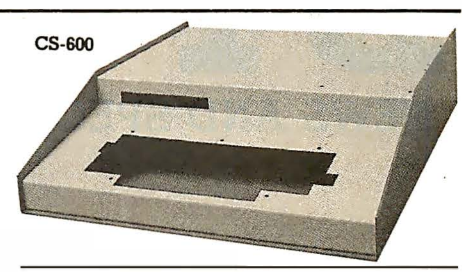
Software:

Ohio Scientific and independent suppliers offer hundreds of programs for the Superboard II, in cassette and mini-floppy form. Here is a sampling of popular Ohio Scientific programs for the Superboard II.

EDUCATIONAL PROGRAMS	SBII&C1P	Price
BASIC Tutor Series	SCE-336	$35.00
Clock Tutor	SCE-353	6.50
Continents Quiz	SCE-332	6.50
Definite Integral	SCE-326	6.50
French Drill & Tutor	SCE-339	6.50
German Tutor & Drill	SCE-342	6.50
Hangman (8K)	SCE-324	9.00
Log Tutors 1-3	SCE-344	6.50
Math Blitz	SCE-329	6.50
Math Intro	SCE-319	6.50
Mathink	SCE-337	9.00
Matrix Tutors 1-3	SCE-345	6.50
Metric Tutor & Quiz	SCE-335	6.50
Spanish Drill & Tutor	SCE-352	6.50
Spelling Quiz	SCE-333	6.50
Trig Tutor (8K) I & II	SCE-318	6.50
BUSINESS PROGRAMS		
Address Book	SCB-523	9.00
Advertisement Demo	SCB-520	6.50
Inventory Demo	SCB-518	6.50
Mailing List (8K)	SCB-524	6.50
Straight & Constant Depreciation	SCB-500	9.00
Time Calculator	SCB-525	9.00
PERSONAL PROGRAMS		
Biorhythm	SCP-716	9.00
Calorie Counter	SCP-708	6.50
Checking Account	SCP-719	9.00
Loan Finance	SCP-717	6.50
Personal Calendar	SCP-718	6.50
Savings Account	SCP-720	9.00
GAME PROGRAMS		
Baseball I	SCG-975	6.50
Black Jack	SCG-955	6.50
Civil War	SCG-977	6.50
Destroyer	SCG-951	6.50
High Noon	SCG-960	6.50
Hockey	SCG-979	6.50
Lander	SCG-925	6.50
New York Taxi	SCG-956	6.50
Poker	SCG-962	6.50
Racer	SCG-949	6.50
Space War	SCG-942	6.50
Star Trek	SCG-946	6.50
Star Wars	SCG-926	6.50
Tic-Tac-Toe	SCG-945	6.50
Tiger Tank	SCG-950	14.00



610 Board



CS-600

Hardware:

Superboard II as specified in the advertisement.		$279
610 Board	For use with Superboard II and Challenger 1P, 8K static RAM expandable to 24K or 32K system total. Accepts up to two mini-floppy disk drives. Requires +5V@ 4.5 amps.	298
Mini-Floppy Disk Drive	Includes Ohio Scientific's PICO DOS software and connector cable. Compatible with 610 expander board. Requires +12V@ 1.5 amps and +5V@ 0.7 amps.	299
630 Board	As specified in the advertisement.	229
AC-3P	12" combination black and white TV/video monitor.	159
4KP	4K RAM chip set.	79
PS-005	5V 4.5 amp power supply for Superboard II.	35
PS-003	Mini-floppy power supply.	29
C1P Sams	C1P/Superboard II Manual.	8
OS-65D	V3.2 Disk Operating System with 9-digit extended BASIC, random access and sequential files.	49
CS-600	Metal case for Superboard II, 610 and 630 board and two power supplies.	49
CS-610	Metal case for single floppy disk drive and power supply.	49
AC-12P	Wireless AC remote control system. Includes control console, two lamp modules and two appliance modules for use with 630 board.	175
AC-17P	Home security system. Includes console, fire detector, window protection devices and door unit for use with 630 board.	249
C4P Sams	C4P Manual.	16
C3 Sams	Challenger III Manual.	40

To Order:
Or to get our free catalog **CALL 1-800-321-5805 TOLL FREE.**
Charge your order to your **VISA** or **MASTER CHARGE** ACCOUNT
Ohio Residents Call: (216) 464-8047. Or write, including your check or money order, to the address listed below.

CLEVELAND CONSUMER COMPUTERS & COMPONENTS
P.O. Box 46627
Cleveland, Ohio 44146

Order Form:
CLEVELAND CONSUMER COMPUTERS & COMPONENTS **P.O. Box 46627 Cleveland, Ohio 44146**

☐ Superboard II $279. ☐ 630 Board $229.
☐ 610 Board $298. ☐ AC-3P 12" B-W Monitor $159.
☐ Mini-Floppy Disk Drive $299. ☐ C1P Sams Manual $8.
(Attach separate sheet for other items.)

NAME:____________________
ADDRESS:____________________
CITY:__________ STATE:__________ ZIP:__________
Payment by: VISA: __ MASTER CHARGE: __ MONEY ORDER: __
Credit Card Account #____________________
Expires:__________ Interbank # (Master Charge)__________
TOTAL CHARGED OR ENCLOSED: $______ (Ohio Residents add 5.5% Sales Tax)
All orders shipped insured UPS unless otherwise requested. FOB Cleveland, Ohio.

Circle 102 on inquiry card.

BYTELINES

NEWS AND SPECULATION ABOUT PERSONAL COMPUTING

Conducted by Sol Libes

Radio Shack's New Products: This fall, Radio Shack will offer a $399 terminal/modem combination called the Videotex. This product will be billed as "the world's first low-cost home/office two-way information-retrieval system," and will allow a user to access CompuServe's MicroNet information utility and similar services.

The Videotex will connect directly to a telephone line and to the antenna terminals of a standard television set (not supplied).

A $30 software package will be required for a TRS-80 Model I to use the MicroNet system. In a radical departure from its past marketing policy, Radio Shack will also sell versions of the access software for non-TRS-80 computer systems such as the Apple II computer.

The MicroNet service will be accessible from 235 sites in the United States, providing news, syndicated columns, and sports, as well as access to credit-card verification and limited banking services.

Observers of the microcomputer industry have been expecting an announcement of three new Radio Shack computer products at any time now. A replacement for the TRS-80 Model I is due, and anticipation of more advanced systems is mounting.

Sharp To Introduce Under-$125 Computer: Sharp Corporation, of Japan, plans to introduce in 1981 an under-$125 handheld computer, which is programmable in BASIC. It will store up to 400 program steps and have twenty-six memory locations for data storage. It will have an alphanumeric keyboard and a one-line LCD (liquid-crystal display). Optional printer and cassette interfaces will also be offered. Sharp is presently marketing a similar, but more powerful, machine in Japan, for $175.

Japanese Show Personal Computers in US: Several Japanese companies showed personal-computer systems at the recent National Computer Conference (NCC) in Anaheim, California. Nippon Electric Company (NEC) displayed a Z80-based system that currently sells for $730 in Japan. It includes a 12-inch color monitor, up to 64 K bytes of programmable and read-only memory and uses Microsoft BASIC.

Casio presented a system with 4½-inch video display and 4 K bytes of main memory, expandable to 32 K. SDC International Corporation said it is preparing to market an S-100-based system.

68000, Where Art Thou? Two computer-system manufacturers have reported to me that they are in a "holding" position on 68000-based 16-bit microcomputer-system development. They claim that Motorola has still not clearly defined some of the operation codes and will not commit to delivery on anything other than sample quantities. These manufacturers contend that similar problems occurred with the 6809 microprocessor. At this point, it does not appear likely that any 68000 products will become available this year.

Wanted: One And A Half Million Programmers: "There could be a demand for over one million computer programmers by 1990," said Andrew S Grove, Intel's president, in a recent interview. *Datamation* magazine has gone even further. In a recent article it reported that new software breakthroughs will cause the number of software programmers to increase 10% per year from 563,000 in 1980 to 1.5 million in 1990.

Japanese Memories Superior? According to a report made by Richard W Anderson, manager of Hewlett-Packard's Data Systems Division, Japanese 16 K memory devices are superior to US-made devices. According to Anderson, Japanese 16 K components showed a zero failure rate on incoming inspection compared to a 0.11 to 0.19% rate on US-made devices (ie: 100 failures out of 50,000). Further, field failures for 1000 hours of operation were 0.010 to 0.019% for Japanese parts versus 0.059 to 0.267% for US-made parts.

World Computer Chess Championship: The third world computer chess championship is scheduled to take place this month in Linz, Austria, from September 25 thru 29.

The former world champion program, Kaissa (from the Moscow Institute of System Studies), will provide strong competition for the best programs from the West. The current World and North American champion, Chess 4.9 (written by David Slate and Larry Atkin) will defend its title alongside other entries from the United States such as Belle, Chaos, and Duchess. The current European champion, the program Master, is also expected to compete.

As in previous tournaments, David Levy will be the Tournament Director. Mr Levy is an International Master of chess and has been noted for his own play versus computer programs.

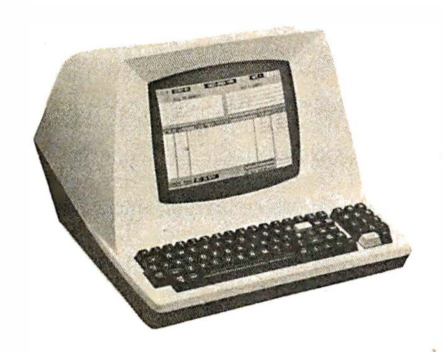
Where Can I Store Ten Gigabits? Optical disks are expected to be the next major advance in high-density mass storage. Capacities of 10,000,000,000 bits (10 gigabits) are expected by 1982, 10^{12} bits (1 terabit) by 1985, and 10^{14} (100 terabits) by 1989. Videodisk technology is also advancing rapidly, but one shortcoming is that video disks are not erasable, limiting them to archival storage. Some systems now being designed are said to offer 10 billion bytes of storage on a 12-inch disk with 250 ms access time.



Toll-Free Ordering

1-800-854-6003 Outside Calif.

714-739-4701 Inside Calif. Outside Cont. USA







TERMINALS

Televideo 912	$745
Televideo 920	795
Soroc IQ-120	700
Zenith A-19	850
Hazeltine 1410	750
Hazeltine 1420	830
Hazeltine 1500	950
Hazeltine 1510	1050

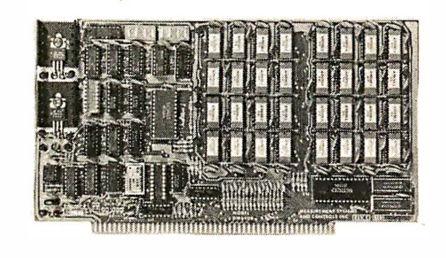
NORTHSTAR

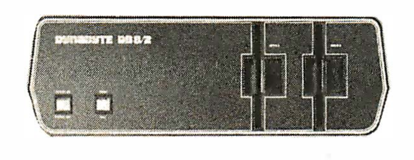
HRZ-1-32K-D	$2100
HRZ-2-32K-D	2340
HRZ-1-32K-Q	2450
HRZ-2-32K-Q	2690
Additional 16K RAM	365
Additional 32K RAM	565
HARD DISC SYSTEM	3950

DM6400 64K RAM MAY BE SUBSTITUTED FOR ASM 32K NORTHSTAR FOR $150. NORTHSTARS WITHOUT MEMORY AVAILABLE.

PRINTERS

NEC 5510	$2700
NEC 5520	2975
MALIBU	2295
TI-810	1580
TI-820	1650
EPSON	CALL
OKIDATA	CALL
ANADEX DP-8000	795
ANADEX DP-9500	1350
BASE 2 800 MST	600





BOARDS	KIT	ASM
CB2 Z80CPU	$168	$220
VB1B VIDEO	125	170
VB2 VIDEO	135	188
VB3 VIDEO	300	347
IO4 INTERFACE	135	188
SBI SYNTHESIZER	161	227

MEASUREMENT SYSTEMS MEMORY

DM3200 32K 4MHZ DYNAMIC	500
DM6400 64K 4MHz DYNAMIC	640
DMB3200 32K BANK SELECT RAM	650
DMB6400 64K BANK SELECT RAM	790

DYNABYTE

DB 8/1 48K	$2395
DB 8/1 64K	2715
DB 8/2 48K	3900
DB 8/2 64K	4200
DB 8/4 SINGLE	3030
DB 8/4 DUAL	3830
10M WINCHESTER	4630
32M PHOENIX	11800
64M PHOENIX	15000
96M PHOENIX	18000

MORROW

DISCUS-1 1 DRIVE	$ 815
DISCUS-1 2 DRIVE	1465
DISCUS 2D 1 DRIVE	970
DISCUS 2D 2 DRIVE	1635
DISCUS 2 + 2 1 DRIVE	1265
DISCUS 2 + 2 2 DRIVE	2245
DISC JOCKEY 1	190
DISC JOCKEY 2D	350
DISCUS M26 HARD DISC	4095
ADDITIONAL HARD DISC	3685

SOFTWARE

CPM-2	$ 150
CBASIC-2	100
WORDSTAR	350
MP/M	300
N.S. PASCAL	175
WHATSIT	170
SELECTOR C-III	280

ADDITIONAL DISCOUNTS FROM OUR SOFTWARE PRICES WHEN PURCHASING A SYSTEM FROM US.

GRAHAM-DORIAN		STRUCTURED SYS	
JOB COSTING	$950	ACCTS REC	$950
INVENTORY	550	ACCTS PAY	950
CASH REG	550	GEN LEDG	950
APARTMENT	550	PAYROLL	950
MEDICAL	950	INVENTORY	950

MISC

ATARI 400	$450
ATARI 800	790
TI 99-4	CALL
RS 232 CABLE 5′	20
RS 232 CABLE 10′	25
LEDEX MONITOR	125
NOVATION CAT	165

DISCS-BOX OF 10

VERBATUM 5¼	1 SIDE	$28
VERBATUM 5¼	2 SIDE	45
VERBATUM 8	1 SIDE	35
VERBATUM 8	2 SIDE	55
OTHERS		CALL

We will try to beat any advertised price.

Automated Equipment Inc.
Suite #D
4341 W. Commonwealth Ave.
Fullerton, Calif. 92633

OPEN MON-FRI 8 AM TO 5 PM

TERMS: All prices listed are cash discounted and are subject to change or withdrawal. Credit cards and COD's are accepted at 2% additional handling charge. Universities and Well Rated Firms NET-10.

SHIPPING: ADDITIONAL IN ALL CASES.

TECH. ASSISTANCE: WE TRY TO HELP INTERFACE AND TROUBLESHOOT CALL 714-739-4701

Circle 103 on inquiry card.

Bubble Memory Update: The first bubble-memory components were introduced in 1977 by Texas Instruments and Rockwell International. The number of bubble-memory suppliers has now increased substantially and includes Intel, Fujitsu, National Semiconductor, and Hitachi. Furthermore, Motorola and Siemens are second-sourcing the Rockwell device. It is likely that several other semiconductor makers will also enter the market.

Intel was the first to introduce a 1-megabit bubble-memory device, last year. Texas Instruments followed a few months later with its 1-megabit unit, and Rockwell is expected to announce its unit shortly.

Further, several manufacturers are also supplying support integrated circuits for simpler construction of the bubble-memory controller.

At this time, the major problem to acceptance of these devices is the lack of standardization. The available devices and support circuits from different manufacturers are not compatible. A Joint Electron Device Engineering Council (JEDEC) committee is currently holding discussions toward establishing standards on device design, reliability, testing, interfacing, and terminology. There still is no agreement as to whether the standard should apply to the device or to the controller level. Hence, it seems that a bubble-memory standard is still some time off, and we are unlikely to see bubble memory in wide use for some time to come.

Kentucky Farmers Get Viewdata: One hundred Kentucky farmers are trying out a Viewdata-type service to get information on markets, local crop conditions, and weather. The service is called the "Green Thumb Agricultural Weather Marketing Project." Using a box attached to a television set and phone line, a farmer can request information from the State's HP-3000 time-sharing computer, by means of a menu-oriented prompting system augmented by local county Z80-based computer systems. Up to eight items may be requested per telephone call. Currently one hundred farmers are testing the units made by Motorola in cooperation with Radio Shack.

Xerox, DEC, And Intel Join Forces For Office Network: Xerox, Digital Equipment Corporation, and Intel have joined forces in an effort to create a new internal data-communications network for business offices. Called Ethernet, it is intended for large or complex business offices. It will link together different types and makes of automated office machines (eg: terminals, intelligent copiers, word processors, etc) into a single system. Xerox holds the basic patents and will license others to manufacture compatible Ethernet products. A prototype system with several hundred machines is reported to have been operating for five years.

Large-Size Flat Display Technique Announced: RCA Laboratories, one of the leaders in display technology, has disclosed a new technical concept for building a wall-mounted 50-inch (diagonal-measure), color, flat-panel television display. A paper presented at the recent annual Society of Information Display conference estimated that the display could be in production by 1990. The display would consist of forty 1-inch-wide by 30-inch-high modules fastened together, side by side, to form a display 40 inches wide by 30 inches high. Each module would contain an electron gun and beam-guide system.

Othello Tournament Results: The best human player of the game Othello can still beat the best Othello-playing computer programs. This we conclude from the results of the First International Man-Machine Othello Tournament, held on June 19, 1980, on the campus of Northwestern University in Evanston, Illinois. Six of the best computer programs and the top two human players participated in a seven-round round-robin tournament. Mr Hiroshi Inoue, the current world champion from Tokyo, Japan, defeated five of the programs and the other human entry, Mr Jonathan Cerf of New York, New York, to win the tournament. Mr Cerf is the United States' Othello champion and is considered to be second-best in the world, although he placed third in this tournament.

The second-place finish was obtained by the computer program written by Dan and Kathe Spracklen of San Diego, California, who are well known for their chess-playing program, Sargon. The Spracklens' program defeated Cerf in the fourth round of the tournament; this defeat was somewhat ironic because Mr Cerf had given the Spracklens help in refining their game-playing algorithms.

Mr Inoue was narrowly defeated by only one opponent, a program called "The Moor" written by David Levy, Michael Stean, and Michael Reeve, all of London, England. This defeat, like the defeat of Cerf by the Spracklens' program, took place in the fourth round. Since the fourth round took place immediately after lunch, many observers have speculated that digestive factors may have impaired the performance of the human players. Oddly enough, The Moor was soundly beaten by programs which were themselves soundly beaten by Mr Inoue.

Fourth place in the final standings went to the program Odin, written by Peter Frey of Northwestern University. Fifth place was occupied by the program Iago, written by Paul Rosenbloom of Carnegie-Mellon University, followed by The Moor in sixth place. Peter Nachtwey, a US naval officer stationed in Newfoundland, Canada, entered his program Reversi Master which ended up in seventh place. Last place was occupied by a program written by Tom Truscott and Dennis Rockwell of Duke University.

Look for a full report on this tournament in a future issue of BYTE. (The name Othello is a trademark of Gabriel Industries, a subsidiary of CBS, Inc.)

AMSAT-OSCAR Phase III Satellite Crashes: When the first stage of the French Arriane rocket exploded during launch on Friday, May 23, 1980, the OSCAR Phase III satellite was lost. The spacecraft had an equivalent value of $250,000 and had required thirty man-years of effort for design and construction. The launch was not insured, so the Radio Amateur Satellite Corporation (AMSAT) has had to absorb a major loss.

The Phase III spacecraft appeared on the cover of the November 1978 BYTE and was discussed in Joe Kasser's article "The Sky's the Limit: Use Ham Radio Bands for Intercomputer Communication" (November 1978 BYTE, page 48). Part of the planned use of the satellite was to have been relaying of computer data by amateur radio operators in personal computer networks.

AMSAT is determined to build a second spacecraft (Phase III-B) to replace the lost unit, but the new satellite may take two years to complete. Fortunately, some material was left over from the original construction and may be used now.

The Empire has expanded!

New Mainframe opens more areas for development

In one quantum leap Tarbell has expanded its popular Empire (the vertical disk subsystem) into a full line. This entire series now encompasses 5 variations. Each one contains different components so the S-100 system designer, hobbyist, or serious business user can arrive at the exact custom state he wants and needs.

The basic Empire still includes two Shugart or Siemens 8" disk drives; the compact cabinet with fan and power supply; a Tarbell floppy disk interface; CP/M*; Tarbell BASIC; the necessary cables, connectors and complete documentation. Naturally, it's fully assembled and Tarbell tested.

The new, top of the line Empire contains the basic model's components with the Tarbell design-approved Mainframe. Beside the 8-slot S-100 motherboard with an active terminated bus, there's a cardcage with card guides and a double-density interface.

You're the master of your Empire

You can call the shots in the Empire. Tarbell's made sure of that by offering them as complete subsystem packages . . . or, as separate units. For example, the mainframe may be ordered with 1, 2 or no drives. Whichever way you go, however, you always get the reliability of Tarbell tested components and leadership-engineering.

To get control of your own Empire, see your quality computer store for quick delivery. Or, contact us for dealer locations or further information.

CP/M is a trademark of Digital Research.



950 Dovlen Place - Suite B
Carson, California, 90746
(213) 538-4251 / 538-2254

Circle 104 on inquiry card.

AMSAT is continuing to develop software to be used by ground stations in the satellite networks and is seeking support from personal computer users in this software-development effort and in other areas of the rebuilding program. Information on AMSAT and its programs may be found in *Orbit*, which is published every two months and received by all members of the AMSAT group. A year's membership may be obtained for $10 from AMSAT, POB 27, Washington DC 20044.

The AMSAT space program is not a complete loss, however. The Phase II OSCAR-8 satellite continues in orbit, and a group of radio amateurs from the University of Surrey in England will launch the scientific-research satellite UOSAT in late 1981. Carrying a coherent high-frequency beacon, a magnetometer, and a slow-scan television camera, the "bird" will provide opportunity for ham radio and personal-computer users to gain experience in tracking satellites and monitoring telemetry.

Random Bits: It is interesting to note that IBM, via its Science Research Associates subsidiary, is marketing the Atari personal computer to educational users. In fact, IBM is offering a special sale. If you buy one Atari Model 800 system, they will give you an Atari Model 400 system free....Avalon-Hill, well known in the war gaming field for its historical simulation board games, has introduced a line of microcomputer-assisted games for the TRS-80, Apple II, and Commodore PET....The sales of the Texas Instruments (TI) Model 99/4 personal computer have been so disappointing that in the Los Angeles area TI has started offering $100 worth of free software plus a $100 cash rebate....Apple Computer Company has shifted its Apple II production from Silicon Valley to Carrolton, Texas, a mere 30 miles away from the new 100,000-square-foot plant Tandy has built to make TRS-80s....A record 82,000 people attended the National Computer Conference (NCC), in Anaheim, California, this past May. The NCC is the largest computer show in the world. When it was held in Anaheim two years ago, 55,000 attended, which set the record just smashed....Data General has begun selling its business-oriented microcomputer systems through independent computer stores nationwide....Fujitsu America Inc, Lake Bluff, Illinois, has announced a plug-in "Bubble Memory Cassette." It provides a portable, detachable, read/write block of 64 K bits. Fujitsu has also introduced a new fully-formed-character printer with speeds up to 80 cps (characters per second), nearly twice the speed of conventional daisy-wheel machines. The printer is currently offered as a $4500 option to a word-processor system....Texas Instruments is now making the voice-synthesizer components used in the Speak & Spell and talking Language Translator available separately at $13 in OEM (original equipment manufacturer) quantity....Shugart Technology, BASF, Control Data, and Erwin International, Ann Arbor, Michigan, are all expected to have 5-inch Winchester hard-disk drives available by the year's end....Commodore will be the first US manufacturer to use the new low-cost Shugart/Matsushita 5-inch floppy-disk drive....Zilog and Mostek have both announced that 6 MHz versions of the Z80 microprocessor will be available in production quantities next year.

Random Rumors: It is rumored that Commodore will soon introduce two low-end personal-computer systems. One will be a black-and-white unit for under $500 and the other a color unit for under $800....Apple may be working on a low-end consumer computer that will compete with Mattel's Intellivision....Personal Software, Sunnyvale, California, the folks who brought out Microchess and VisiCalc (probably the two largest-selling personal-computer software packages to date) are rumored about to release VisiText, a superpowerful text editor with features never before seen....NEC (Nippon Electric Corporation) is rumored to be investigating selling its Model PC-8000 microcomputer here in the US, after selling it in Japan for some time.

IBM Demonstrates Continuous Voice Recognition: IBM research scientists, at the Thomas J Watson Research Center in Yorktown Heights, New York, have demonstrated that continuous speech can be recognized by a computer with an accuracy of 91%. In continuous speech there are no pauses between words. In the IBM experiment, the computer transcribed normal-speed speech into printed form. The program took 100 minutes to display or type a transcript of a 30-second sentence. In other words, it has a 200:1 response-time ratio. The experiment proves that continuous speech recognition by computers is possible.

UCSD Pascal Controversy Continues: Several former University of California, San Diego (UCSD) Pascal licensees are threatening to file suit against UCSD and its new exclusive licensee, SofTech Microsystems. The licensees charge that UCSD violated the "fair use doctrine" in arbitrarily cancelling their licenses only a short time before the software would have entered the public domain.

About thirty organizations, mostly computer hobbyist clubs, paid $200 to $300 for a UCSD Pascal license that permitted distribution of the software to their members and, after two years, would have placed no restrictions on copying the software.

These licensees are also upset over what they charge to be software developed with public funds now being sold by a private organization. SofTech counters this charge by asserting that it is merely an agent of the university and that it intends to spend as much money on developing UCSD Pascal as did the university.

One UCSD Pascal purchaser had an uncancellable license: Apple Computer Company. Its license, however, is restricted exclusively to use of the software on Apple Computer systems.

Terminal Gets Voice Input: Heuristics Inc of Sunnyvale, California, has introduced a speech-recognition system which works with a Lear Seigler ADM-3A video terminal. The unit, called VOCON 5000, recognizes 64 words or phrases that can control a program being run on the computer. A 99% recognition rate is claimed for the unit, which sells for $2000.

MAIL: I receive a large number of letters each month as a result of this column. If you wish a response, please include a stamped, self-addressed envelope.

Sol Libes
Amateur Computer Group of New Jersey (ACG-NJ)
1776 Raritan Rd
Scotch Plains NJ 07076



Facts About Club Membership

- The 6 introductory books of your choice carry publisher's retail prices of up to $105.70. They are yours for only $2.95 for all 6 (plus postage/handling) with your Trial Membership.
- You will receive the **Club News**, describing the current Selections, Alternates, and other books, every 4 weeks (13x a year).
- If you want the Selection, do nothing, it will be sent to you automatically. If you do not wish to receive the Selection, or if you want to order one of the many Alternates offered, you simply give instructions on the reply form (and in the envelope) provided, and return it to us by the date specified. This date allows you at least 10 days in which to return the form. If, because of late mail delivery, you do not have 10 days to make a decision and so receive an unwanted Selection, you may return it at Club expense.
- To complete your Trial Membership, you need buy only four additional monthly Selections or Alternates during the next 12 months. You may cancel your Membership any time after you purchase these four books.
- All books—including the Introductory Offer—are fully returnable after 10 days if you're not completely satisfied.
- All books are offered at low Member prices, plus a small postage and handling charge.
- **Continuing Bonus.** If you continue after this Trial Membership, you will earn a Dividend Certificate for every book you purchase. Three Certificates plus payment of the nominal sum of $1.99 will entitle you to a valuable Book Dividend of your choice which you may choose from a list provided Members.

May we send you your choice of 6 of these practical time-and-money-saving books as part of an unusual offer of a Trial Membership in Electronics Book Club?

Here are quality hardbound volumes, each especially designed to help you increase your know-how, earning power, and enjoyment of electronics. Whatever your interest in electronics, you'll find Electronics Book Club offers practical, quality books that you can put to immediate use and benefit.

This extraordinary offer is intended to prove to you through your own experience, that these very real advantages can be yours...that it *is* possible to keep up with the literature published in your areas of interest, and to save substantially while so doing. As part of your Trial Membership, you need purchase as few as four books during the coming 12 months. You would probably buy at least this many anyway, without the substantial savings offered through Club Membership.

To start your Membership on these attractive terms, simply fill out and mail the coupon today. You will receive the 6 books of your choice for 10-day inspection. YOU NEED SEND NO MONEY. If you're not delighted, return the books within 10 days and your Trial Membership will be cancelled without cost or obligation.

ELECTRONICS BOOK CLUB, Blue Ridge Summit, Pa. 17214

ELECTRONICS BOOK CLUB

Blue Ridge Summit, Pa. 17214

Please open my Trial Membership in ELECTRONICS BOOK CLUB and send me the 6 books circled below. I understand the cost of the books I have selected is only $2.95 for all 6, plus a small shipping charge. If not delighted, I may return the books within 10 days and owe nothing, and have my Trial Membership cancelled. I agree to purchase at least four additional books during the next 12 months after which I may cancel my membership at any time.

800 801 804 971 985 1000 1050 1053
1055 1066 1077 1088 1101 1123 1136 1141
1169 1183 1184 1199 1203 1205 1225 1241

Name ____________ Phone ________

Address ____________

City ____________

State ____________ Zip ________

(Valid for new Members only. Foreign and Canada add 15%.) BY-980

Circle 105 on inquiry card.

3 p.m.	Investment Analysis of Stocks and Commodities on a Microcomputer, Fred Cohen, Shearson Loeb Rhoades, Inc.
4 p.m.	Advantages of Distributed Processing and Multi-Processing, John Steefel, Q1 Corp.
4 p.m.	To be assigned.

SATURDAY, NOVEMBER 1

Noon	Educational Software: The Good, the Bad, the Ugly. Jo Ann Comito, S.U.N.Y. at Stony Brook
Noon	Introduction to Personal Computing, RCA—Solid State
1 p.m.	Computer-Assisted Mathematics Courses, Dr. Frank Scalzo, Queensborough Community College
1 p.m.	Artificial Intelligence Update, Prof. Peter Kugel, Boston College
2 p.m.	Compiling and Retrieving Personal Medical Data, Dr. Derek Enlander, St. Luke's Hospital
2 p.m.	The Present State of CP/M Compatible Software, Tony Gold, Lifeboat Associates
3 p.m.	High Volume Date Handling: An Introduction to File Processing, Prof. Peter Kugel, Boston College
3 p.m.	Connecting the Computer to the Outside World, Prof. James Gips, Boston College
4 p.m.	Educational Applications in the Home, David Ahl, "Creative Computing Magazine"
4 p.m.	Household Applications—Some New, Dr. Dennis J. McGuire

SPECIAL SESSION: EXECUTIVE EDUCATION CONFERENCE FOR BUSY PEOPLE

This year, NSCS will present a special five-hour conference formulated as an intensive fast education for administrators and executives. The aim is to show the conferee how to cope with computers in business. No prior knowledge of computers is needed. The session will proceed on a step-by-step basis, covering computers, computer jargon, software, systems, and peripherals. It will indicate how to assess computer requirements, how to talk to vendors, and how to make a system work efficiently, after you've bought it wisely.

An executive education session will be given daily for four days, Oct. 29 through Nov. 1, in the New York Coliseum. Each session is limited in attendance, and reservation must be made. Registration is on a first-come, first-served basis. Fee is $200, and includes three-day admission to the National Small Computer Show, coffee break, and workbook materials. Please write or call the show office for session outline and registration form. (Do not use registration form in this ad). Seminar instructor is Barbara Schwartz, author and seminar leader for private industry.



Computer Show

Circle 106 on inquiry card.

REGISTRATION FOR AMERICA'S BIGGEST SMALL COMPUTER SHOW

Please register me for the 4th Annual National Small Computer Show, Oct. 30 - Nov. 1, 1980 New York Coliseum.

NAME ____________ BUSINESS TITLE (If Any) ____________

COMPANY (If Any) ____________ TELEPHONE ____________

ADDRESS ____________ ZIP ____________

Your company's primary business. Check one.

1 ☐ Accounting firm
2 ☐ Advertising/Marketing
3 ☐ Banking/Insurance/Real Estate/Credit/Securities
4 ☐ Communications
5 ☐ Computer Consultant
6 ☐ Computer Dealer/Dist
7 ☐ Construction/Architecture
8 ☐ Education
9 ☐ Engineering
10 ☐ Entertainment.News
11 ☐ Government/Military
12 ☐ Hospital
13 ☐ Hotel
14 ☐ Industrial Design
15 ☐ Law Office
16 ☐ Management Consultant
17 ☐ Manufacturing
18 ☐ Personnel Agency
19 ☐ Professional Services
20 ☐ Research/Development
21 ☐ Transportation (All)
22 ☐ Utility
23 ☐ Wholesale/Retail Sales
24 ☐ Other (Please Specify) ____________

Check your primary job function.

1 ☐ Account Executive
2 ☐ Administrator
3 ☐ Bookkeeper
4 ☐ Chemist/Pharm
5 ☐ Consultant
6 ☐ Corporate Officer
7 ☐ C.P.A.
8 ☐ Creative Arts (All)
9 ☐ Designer (All)
10 ☐ DP/WP Manager/Operator
11 ☐ Doctor
12 ☐ Engineer (All)
13 ☐ Lawyer
14 ☐ Office Manager
15 ☐ Programmer
16 ☐ Purchasing
17 ☐ Salesperson (All)
18 ☐ Scientist
19 ☐ Skilled Laborer
20 ☐ Student
21 ☐ Teacher
22 ☐ Technician
23 ☐ Other (Please Specify) ____________

Your primary interest in computers (check only one) 1 ☐ Business 2 ☐ Personal 3 ☐ Both

☐ ONE DAY $10 ☐ TWO DAYS $20
☐ THREE DAYS $30

Mail with payment of $10 for each day you wish to attend. Use one form per person. Registration badge will be sent by mail in early October. Check or money order only.

Mail prior to October 10, 1980.
Foreign orders: October 1, 1980.
National Small Computer Show
110 Charlotte Place
Englewood Cliffs, NJ 07632
201-569-8542

Ask BYTE

Conducted by Steve Ciarcia

Levels to Bits

Dear Steve,

I have been shopping around for the analog-to-digital (A/D) converter integrated circuit that you used in your wood-stove interface (see "A Computer-Controlled Wood Stove," February 1980 BYTE, page 32), but it does not seem to be readily available.

C W Vuaun

I try to avoid specifying components that are not commonly available. While I obtain parts through industrial distributors rather than surplus outlets, I check the latter often to see what is available. In the case of the ADC0808, the time-lag is greater than I expected. However, in the meantime there is a sixteen-channel version, the ADC0816CCN, which is the same in every respect (except that it has twice as many channels). It is available from Digi-Key Corporation, POB 677, Thief River Falls MN 56701. Their toll-free phone is (800) 346-5144. Call or write them for the current price. **Steve**

More Power

Dear Steve,

I noticed your comment on UPSs (uninterruptible power supplies) in the June 1980 BYTE (see "Ask BYTE," page 86), and thought I would mention that they are commercially available in sizes small enough to be useful to personal-computer users (see the Hardside catalog, page 34). I do not know who the actual manufacturer is, but I would like to know more about these items. The devices I am concerned with have specifications that accommodate 60 and 120 Hz power, with and without surge protection, and supply 150 or 200 W. The trade name is "Mayday."

R M Sanford

Thank you for pointing out the Mayday UPS. It is manufactured by Sun-Technology Inc, which is located in New Durham, New Hampshire. The Mayday UPS is available from Hardside, 6 South St, Milford NH 03055, (800) 258-1790. According to the Hardside catalog, prices begin at $168.... **Steve**

A Hot Tip

Dear Steve,

The solid-state sensor you described for your wood stove (see "A Computer-Controlled Wood Stove," February 1980 BTYE, page 50) is very interesting. I have constructed the circuit, but I am having trouble calibrating the device for a range of −18 to +100°C.

Ron Goodmaster

The circuit you refer to can be calibrated in a number of ways. There is an offset and gain adjustment included for this purpose.

In normal practice, say for a range of 0° C to 100° C, we would adjust for offset so that the output was 0 V with the temperature probe in an ice bath and adjust the gain so that the output is 1.00 V when it is placed in boiling water. To have it actually read −18° as −0.18 V you will have to modify the circuit slightly. Presently the 50 k offset-adjustment potentiometer is connected between +12 V and ground. By connecting it instead between +12 V and −12 V you can impress a negative current flow into IC2 such that it has a negative offset. The gain of the circuit will now have to be adjusted for a 118-degree span instead of 100 degrees. The trick is that to accurately calibrate the unit you should have a −18° C standard when you set the low end. Substituting a voltage source for the LM334 will only give you a relative calibration, but it may be all you need.... **Steve**

Remote Control at Home

Dear Steve,

The other day I was thumbing through a BYTE magazine and I came across the article you wrote about using the TRS-80 and the BSR X-10 home-control system. (See "Computerize a Home," January 1980 BYTE, page 28.) I had been working on the same project in my spare time, and I had been using opto-isolators for interfacing; however, your method is well above the idea that I was attempting. Your article was very informative and the accompanying software was excellent. I have since looked up your articles in other BYTEs, and I must say that you never fail to come up with interesting and practical pieces.

I have decided to use your method, and I will shortly be purchasing a "Busy Box" from MicroMint in Woodmere, New York.

Whenever I have my TRS-80 up and running, the Sears home-control-unit operation is either marginal or nonexistent. The minute I turn the TRS-80 off, the home-control unit works fine. I assume that the prob-

lem is RFI (radio-frequency interference), but I am not quite sure how to cope with the problem. I know the TRS-80 is a great noise generator, but I know little of how to deal with the problem. If you can give me any help along these lines, I would appreciate it very much. Thanks.

Robert G Romppel

Radio-frequency interference (RFI) is so pervasive among personal computers and consumer electronic gadgets that the Federal Communications Commission (FCC) has extended the long arm of the law. See Terry Mahn's article "FCC Regulation of Personal Computers and Home Computing Devices" on page 180 in this issue.

As for now, there are various alternatives open to you. First, try plugging the BSR unit into a different wall socket than the TRS-80. The range of the Busy Box is 30 feet, so it doesn't have to be right next to the computer anyway. (Avoid extra long extension cords and use a plug strip for the computer and peripherals.) The noise from the computer is being radiated into the power line; therefore you want to put as much electrical distance between the TRS-80 and the X-10 as possible. While there may be five wall outlets in an average room, they are rarely all on the same circuit breaker. For the noise to reach an appliance plugged into another circuit loop, it must first travel back to the breaker box. This is a lot of wire and the resulting inductance will diminish some of the interference.

If that doesn't work, next try to kill the noise at the source (the computer) by placing capacitors at the outlet. I suggest using three 0.1 μF 600 V disc ceramic capacitors, one from each side of the AC line connected to a good earth ground and another across the line. Ordinarily, you would also connect the computer chassis to ground but this is not advisable on the TRS-80.

To really eliminate line noise, you need a combination of inductance and capacitance. Rather than trying to wind your own coils, it is better for you to buy a commercial noise suppressor. You want one that covers at least a range of 100 kHz to about 200 MHz. They are about $20 and up. One company that lists a few in its catalog is: Hardside, 6 South St, Milford NH 03055, (800) 258-1790.

*If none of this works, then encase the entire thing in copper screening and run it on a battery! ...***Steve**

Remote Control on the Farm

Dear Steve,

I am a graduate business student at Colorado State University working with David R Miller, Sun Up Angus Farms, Smithville, Missouri, in establishing an in-house computer system for his ranch. This will also be the topic of my thesis.

Presently the main areas that we see a need for a computer are:

1) *cattle inventory* —pedigree, calving dates, breeding dates, calf weights;
2) *customer service*—date, identification, and price of animals purchased, commercial or registered breeder, size of herd, etc;
3) *accounting system* —basically following the Internal Revenue's 1040 form with some variations;
4) various other programs for feed-ration analysis, investment analysis, profitability, etc.

I am interested in any existing computer programs or any information on the hardware available. Also, if you have any information about the cost, complexity,

KISS OBSOLESCENCE GOODBYE... with RAM XX

RAM XX, our latest static memory board, satisfies discriminating users of ALL S-100 machines while allowing you to keep pace with the state of the art. It's compatible with standard S-100 systems (Altair, IMSAI, etc.); bank select systems (Cromemco, Alpha Micro, North Star, etc.); and IEEE compatible extended addressing systems. **RAM XX** boards are addressable on 4K boundaries and also have the capability to block out 4K windows. Don't throw away your memory boards when you upgrade – with **RAM XX**, simply change a few dipswitch settings and you're on-line with some of the best memory in the business.

As with all our memory products, you derive the benefits of 4/5 MHz operation, fully static design to eliminate dynamic timing problems, IEEE spec compatibility, low power, extensive bypassing, and careful thermal design. In addition, boards qualified under our Certified System Component high-reliability program run at 8 MHz typical and are guaranteed to run with 6 MHz Z80A CPUs; 32K CSC boards draw less than 1.5A guaranteed, with typical standby current of less than 1A.

If you're looking for specs – if you're looking for performance – if you're looking for exceptional value and insurance against obsolescence, look no further than the RAM series from CompuPro.

	unkit	assm	CSC
16K RAM XX-16	**$349**	**$419**	**$519**
24K RAM XX-24	**$479**	**$539**	**$649**
32K RAM XX-32	**$649**	**$729**	**$849**

OTHER S-100 MEMORY (Includes IEEE compatible extended addressing.)

	unkit	assm	CSC
8K RAM IIA	**$169**	**$189**	**$239**
16K RAM XIV	**$299**	**$349**	**$429**

SBC/BLC MEMORY

	unkit	assm	CSC
32K RAM XI	n/a	n/a	**$1050**

COMPUPRO S-100 MOTHERBOARDS: DESIGNED FOR THE FUTURE, AVAILABLE NOW

Specifically designed to handle the new generation of 5 to 10 MHz CPUs coming on line (as well as present day 2 and 4 MHz systems), these advanced motherboards feature Faraday shielding between all bus signal lines to minimize crosstalk, active termination that splits the termination load between each end of every bus line, and mechanical compatibility with Godbout, Vector, Imsai, TEI, and similar enclosures. Available in "unkit" form (edge connectors and termination resistors pre-soldered in place for easy assembly), or fully assembled and ready to go.

#CK-024 20 slot motherboard with edge connectors – unkit $174, assm $214
#CK-025 12 slot motherboard with edge connectors – unkit $129, assm $169
#CK-026 6 slot motherboard with edge connectors – unkit $89, assm $129

NOTE: Most **CompuPro** boards are available in **unkit** form (sockets, bypass caps pre-soldered in place), **assembled**, or qualified under the **Certified System Component** (CSC) high-reliability program (200 hour burn-in, more).

ENHANCED/ADVANCED Z-80A S-100 CPU BOARD

Superior design in a true IEEE-compatible board (timing specs available on request) gives the power for future expansion as well as system flexibility. Includes all standard Z-80A features along with power on jump/clear, on-board fully maskable interrupts for interrupt-driven systems, selectable automatic wait state insertion, provision for adding up to 8K of on-board EPROM, 4 MHz operation, and IEEE compatible 16/24 bit extended addressing. **$225 unkit, $295 assm, $395 CSC.**

SPECTRUM S-100 COLOR GRAPHICS BOARD

Includes 8K of IEEE-compatible static RAM; full duplex bidirectional parallel I/O port for keyboard, joystick, etc. interface; and 6847-based graphics generator that can display all 64 ASCII characters. 10 modes of operation, from alphanumeric/semi-graphics in 8 colors to ultra-dense 256 × 192 full graphics. 75 Ohm RS-170 line output and video output for use with FCC approved modulators. **$339 unkit, $399 assm, $449 CSC.** You don't have to settle for black and white graphics or stripped-down color boards; specify the **CompuPro Spectrum.**

Want graphics software? **Sublogic's 2D Universal Graphics Interpreter** (normally $35) is yours for **$25** with any Spectrum board purchase.

OTHER S-100 BUS PRODUCTS

Godbout Computer Enclosure	**$289 desktop, $329 rack mount**
Active Terminator Board	**$34.50 kit**
2708 EPROM Board (less EPROMs)	**$85 unkit**
Memory Manager Board	**$59 unkit, $85 assm, $100 CSC**
2S "Interfacer I" I/O Board	**$199 unkit, $249 assm, $324 CSC**
3P Plus S "Interfacer II" I/O Board	**$199 unkit, $249 assm, $324 CSC**
Mullen Extender Board	**$59 kit**
Mullen Relay/Opto-Isolator Control Board	**$129 kit, $179 assm**
Vector 8800V S-100 Prototyping Board	**$19.95**

NEW! S-100 DUAL PROCESSOR CPU BOARD

The **Dual Processor Board** is here . . . and CPU boards will never be the same again. 8088 CPU gives true 16 bit power with a standard 8 bit S-100 bus; an 8085 gives compatibility with CP/M and 8080 software. Accesses up to 16 megabytes of memory, meets all IEEE S-100 bus specifications (timing specs available on request), runs 8085 and 8086 code **in existing mainframe** as well as Microsoft 8086 BASIC and Sorcim PASCAL/M™, runs at 5 MHz for speed as well as power, and is built to the same stringent standards that have established our leadership in S-100 bus components. **$385 unkit, $495 assm, $595 CSC.**

8085 single processor version of above: **$235 unkit, $325 assm, $595 CSC.**

PASCAL/M™ + MEMORY SPECIAL

PASCAL – easy to learn, easy to apply – can give a microcomputer with CP/M more power than many minis. We supply a totally standard **Wirth PASCAL/M™ 8" diskette** by **Sorcim**, with manual and Wirth's difinitive book on PASCAL, for **$150 with the purchase of any memory board.** Specify Z-80 or 8080/8085 version. **PASCAL/M™ available separately for $175.**

16K DYNAMIC RAM SPECIAL: 8/$59!

Expand memory in **TRS-80*** -I and -II, as well as machines made by **Apple, Exidy, Heath H89**, newer **PETs**, etc. Low power, high speed (4 MHz). Add $3 for 2 dip shunts plus TRS-80* conversion instructions.

*TRS-80 is a trademark of the Tandy Corporation.

TERMS: Cal res add tax. Allow 5% for shipping, excess refunded. VISA®/Mastercard® orders ($25 min) call (415) 562-0636, 24 hrs. COD OK with street address for UPS. Prices good through cover month of magazine.

SEE COMPUPRO QUALITY FOR YOURSELF AT FINER COMPUTER STORES WORLD-WIDE . . .
AND WATCH FOR OUR AMAZING MULTIFUNCTION BOARD ANNOUNCEMENT IN OCTOBER!



from



Bldg. 725, Oakland Airport, CA 94614

Circle 86 on inquiry card.

satisfaction, or problems encountered in such a system, I am sure I would find it very useful.

My main problem in trying to choose a computer system is in deciding between two very diverse opinions. One opinion is that for a system as I have specified, I need a computer with 64 K bytes of memory and two 8-inch double-density floppy-disk drives for about one million bytes of storage. This would run in the neighborhood of $8000 in hardware (computer, printer, and terminal). The other major opinion is that I could get by with 50 K bytes of memory and 50 K bytes of storage; ie: a system that would sell for $1500 (such as the Intecolor 3600 Series from Intelligent Systems Corporation).

If you could give me any answers these questions, I would greatly appreciate it. Thank you for your time.

Laurie A Miller

It looks to me as though you already have a good idea what kind of computer you need. At least 48 K, preferably 64 K, bytes of memory are required plus dual disks. If your data base is exceedingly large, or a large portion of it must be on-line at one time, make sure you choose a system that is expandable. This could include two more floppy-disk drives or a 10-megabyte or larger Winchester hard disk. If because of finances you choose to start small, select a system that does not require a masters degree in electrical engineering to expand. Time of execution is generally the only real difference between large and small computers. The more disks you have to sort through to find the data you want, the longer it takes to get an answer. The software you want sounds like specific applications of generally available accounting and data-base management programs.

Hardware is only one part of the consideration however. Be aware that you are configuring a classic small-business system and the inventory and data-base management programs would be similar to, say, a dairy cooperative. While the choice of the hardware is important, adequate software and system maintenance are more signficant in the long run. Once the computer is installed it is very easy to become dependent upon it working.

There are many computers on the market that will satisfy your requirements: Cromemco, Hewlett-Packard, and Data General to name a few. The larger computer stores not only sell equipment like this, but offer custom programming and on-call field service as well. Take the time to evaluate the post-sale support for your computer, and check to see if your software will be compatible with other systems.

I do not know much about cattle, but the complaints I've herd—oops!—heard from small-business computer users have been registered.

..**Steve** ■

In "Ask BYTE," Steve Ciarcia answers questions on any area of microcomputing. The most representative questions received each month will be answered and published. Do you have a nagging problem? Send your inquiry to:

Ask BYTE
c/o Steve Ciarcia
POB 582
Glastonbury CT 06033

If you are a subscriber to The Source, send your questions by electronic mail or chat with Steve (TCE317) directly. Due to the high volume of inquiries, personal replies cannot be given. Be sure to include "Ask BYTE" in the address.

Now NRI takes you inside the world's most popular microcomputer to train you at home as the new breed of computer specialist!



NRI teams up with Radio Shack to teach you how to use, program and service microcomputers...make you the complete technician.

It's no longer enough to be just a programmer or a technician. With microcomputers moving into the fabric of our lives (over 200,000 of the TRS-80™ alone have been sold), interdisciplinary skills are demanded. And NRI can prepare you with the first course of its kind, covering the complete world of the microcomputer.

Learn At Home in Your Spare Time

With NRI training, the programmer gains practical knowledge of hardware, enabling him to design simpler, more effective programs. And, with advanced programming skills, the technician can test and debug systems quickly and easily.



Training includes TRS-80 computer, transistorized volt-ohm meter, digital frequency counter, and the NRI Discovery Lab with hundreds of tests and experiments.

(TRS-80 is a trademark of the Radio Shack division of Tandy Corp.)

Only NRI gives you both kinds of training with the convenience of home study. No classroom pressures, no night school, no gasoline wasted. You learn at your convenience, at your own pace. Yet you're always backed by the NRI staff and your instructor, answering questions, giving you guidance, and helping you over the tough spots.

Explore the TRS-80 Inside and Out

NRI training is hands-on training, with practical experiments and demonstrations as the very foundation of your knowledge. You don't just program your computer, you introduce and correct faults ...watch how circuits interact...interface with other systems...gain a real insight into its nature.

You also build test instruments and the NRI Discovery Lab, performing over 60 separate experiments in the process. You learn how your trouble-shooting tools work, and gain greater understanding of the information they give you. Both microcomputer and equipment come as part of your training for you to use and keep.

Send for Free Catalog... No Salesman Will Call

Get all the details on this exciting course in NRI's free, 100-page catalog. It shows all equipment, lesson outlines, and facts on other electronics courses such as Complete Communications with CB, TV and Audio, Digital Electronics, and more. Send today, no salesman will ever bother you. Keep up with the latest technology as you learn on the world's most popular computer. If card has been used, write to:



NRI Schools
McGraw-Hill Continuing Education Center
3939 Wisconsin Avenue
Washington, D.C. 20016.

FCC Regulation of Personal- and Home-Computing Devices

New Rules After a 3-Year Study

Terry G Mahn
Wewer & Mahn PC
1762 Church St NW
Washington DC 20036

If you have been reading BYTE within the last half year, you are probably aware that the FCC (Federal Communications Commission) has handed down a set of regulations prohibiting the sale of personal computers that emit unacceptable levels of RFI (radio-frequency interference). But the FCC has changed its regulations several times, and in any case, information on and interpretation of these rulings have been scarce. I hope to clarify these most recent FCC regulations and to describe how (and when) they will affect you as a personal-computer user or vendor and the industry in general.

It is current FCC policy for computer manufacturers to bear the associated costs of their technology.

It is a common misconception by many in the computer industry that the FCC is empowered by the 1934 Communication Act only to regulate communications providers and users—that is, common carriers, broadcasters, and Citizens Band radio users. This misconception emanates from the nearly decade-old controversy surrounding the Commission's so-called "Computer Rules." First adopted in 1971, these regulations attempted to define the technological boundary line between common-carrier communications and data processing, to identify the FCC's jurisdictional perimeter under Title II (common-carrier services) of the Act. Recently, the computer rules have undergone a major revision in an effort to halt FCC encroachment into the traditionally nonregulated computer and data-processing industries.

The FCC's regulatory reach into the computer industry, however, is not as limited as the Computer Rules might seem to indicate. Title III of the Act (radio services) specifically empowers the FCC to *protect* communications systems from RFI, from whatever source derived. Insofar as virtually all computing devices emit spurious radio frequencies that can potentially interfere with radio or television services, manufacturers and vendors of such equipment come directly within the FCC's Title III jurisdiction.

It is not axiomatic that where federal authority exists, industry regulation and increase of the cost of doing business is sure to follow. (Under Chairman Ferris, for example, the FCC has been particularly notorious in reducing regulation of American industry.) Nevertheless, the FCC has chosen to regulate in this area for purely economic reasons. Because the radio spectrum is a valuable, but limited resource that can be used in various but incompatible ways, simple economic efficiency suggests that such resources be employed in their

About the Author

Terry G Mahn is a principal in the law firm Wewer and Mahn PC in Washington DC, where he specializes in intellectual property protection and licensing, and the legal, regulatory, and policy issues affecting the data processing and telecommunications industries. He has previously served as general counsel to the Computer and Communications Industry Association and as a computer specialist for the US House of Representatives Committee on House Administration. Currently, he is regulatory counsel to MITA (Microcomputer Industry Trade Association).

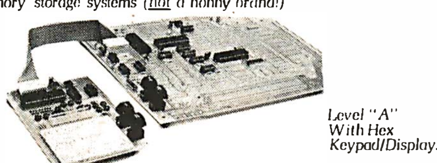
Start learning and computing for only ***$129.95*** *with a Netronics 8085-based computer kit. Then expand it in low-cost steps to a business/development system with 64k or more RAM, 8" floppy disk drives, hard disks and multi-terminal I/O.*

THE NEW EXPLORER/85 SYSTEM

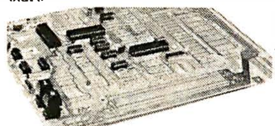
Special! *Full 8" floppy, 64k system for less than the price of a mini! Only* **$1499.95!**

(Also available wired & tested, $1799.95)

Imagine — for only $129.95 you can own the starting level of Explorer/85, a computer that's expandable into full business/development capabilities — a computer that can be your beginner system, an OEM controller, or an IBM-formatted 8" disk small business system. From the first day you own Explorer/85, you begin computing on a significant level, and applying principles discussed in leading computer magazines. Explorer/85 features the advanced Intel 8085 cpu, which is 100% compatible with the older 8080A. It offers onboard S-100 bus expansion, Microsoft BASIC in ROM, plus instant conversion to mass storage disk memory with standard IBM-formatted 8" disks. All for only $129.95, plus the cost of power supply, keyboard/terminal and RF modulator if you don't have them (see our remarkable prices below for these and other accessories). With a Hex Keypad/display front panel, Level "A" can be programmed with no need for a terminal, ideal for a controller, OEM, or a real low-cost start.



Full 8" disk system for less than the price of a mini (shown with Netronics Explorer/85 computer and new terminal). System features floppy drive from Control Data Corp., world's largest maker of memory storage systems (not a hobby brand!)



Level "A" is a complete operating system, perfect for beginners, hobbyists, industrial controller use. $129.95

Level "A" With Hex Keypad/Display.

LEVEL "A" SPECIFICATIONS

Explorer/85's Level "A" system features the advanced Intel 8085 cpu, an 8355 ROM with 2k deluxe monitor/operating system, and an advanced 8155 RAM I/O . . . all on a single motherboard with room for RAM/ROM/PROM/EPROM and S-100 expansion, plus generous prototyping space.

PC Board: Glass epoxy, plated through holes with solder mask. • **I/O:** Provisions for 25-pin (DB25) connector for terminal serial I/O, which can also support a paper tape reader . . . cassette tape recorder input and output . . . cassette tape control output . . . LED output indicator on SOD (serial output) line . . . printer interface (less drivers) . . . total of four 8-bit plus one 6-bit I/O ports. • **Crystal Frequency:** 6.144 MHz. • **Control Switches:** Reset and user (RST 7.5) interrupt . . . additional provisions for RST 5.5, 6.5 and TRAP interrupts onboard. • **Counter/Timer:** Programmable, 14-bit binary. • **System RAM:** 256 bytes located at F800, ideal for smaller systems and for use as an isolated stack area in expanded systems . . . RAM expandable to 64K via S-100 bus or 4k on motherboard.

System Monitor (Terminal Version): 2k bytes of deluxe system monitor ROM located at FØØØ, leaving ØØØØ free for user RAM/ROM. Features include tape load with labeling . . . examine/change contents of memory . . . insert data . . . warm start . . . examine and change all registers . . . single step with register display at each break point, a debugging/training feature . . . go to execution address . . . move blocks of memory from one location to another . . . fill blocks of memory with a constant . . . display blocks of memory . . . automatic baud rate selection to 9600 baud . . . variable display line length control (1-255 characters/line) . . . channelized I/O monitor routine with 8-bit parallel output for high-speed printer . . . serial console in and console out channel so that monitor can communicate with I/O ports.

System Monitor (Hex Keypad/Display Version): Tape load with labeling . . . tape dump with labeling . . . examine/change contents of memory . . . insert data . . . warm star . . . examine and change all registers . . . single step with register display at each break point . . . go to execution address. Level "A" in this version makes a perfect controller for industrial applications, and is programmed using the Netronics Hex Keypad/Display. It is low cost, perfect for beginners.

HEX KEYPAD/DISPLAY SPECIFICATIONS

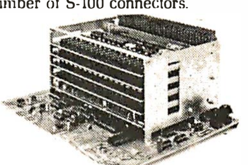
Calculator type keypad with 24 system-defined and 16 user-defined keys. Six digit calculator-type display, that displays full address plus data as well as register and status information.

LEVEL "B" SPECIFICATIONS

Level "B" provides the S-100 signals plus buffers/drivers to support up to six S-100 bus boards, and includes: address decoding for onboard 4k RAM expansion selectable in 4k blocks . . . address decoding for onboard 8k EPROM expansion selectable in 8k blocks . . . address and data bus drivers for onboard expansion . . . wait state generator (jumper selectable), to allow the use of slower memories . . . two separate 5 volt regulators.

LEVEL "C" SPECIFICATIONS

Level "C" expands Explorer/85's motherboard with a card cage, allowing you to plug up to six S-100 cards directly into the motherboard. Both cage and card are neatly contained inside Explorer's deluxe steel cabinet. Level "C" includes a sheet metal superstructure, a 5-card, gold plated S-100 extension PC board that plugs into the motherboard. Just add required number of S-100 connectors.



Explorer/85 With Level "C" Card Cage.

LEVEL "D" SPECIFICATIONS

Level "D" provides 4k of RAM, power supply regulation, filtering decoupling components and sockets to expand your Explorer/85 memory to 4k (plus the original 256 bytes located in the 8155A). The static RAM can be located anywhere from ØØØØ to EFFF in 4k blocks.

LEVEL "E" SPECIFICATIONS

Level "E" adds sockets for 8k of EPROM to use the popular Intel 2716 or the TI 2516. It includes all sockets, power supply regulator, heat sink, filtering and decoupling components. Sockets may also be used for 2k x 8 RAM IC's (allowing for up to 12k of onboard RAM).

DISK DRIVE SPECIFICATIONS

- 8" CONTROL DATA CORP. professional drive.
- LSI controller.
- Write protect.
- Single or double density.
- Data capacity: 401,016 bytes (SD), 802,032 bytes (DD), unformatted.
- Access time: 25ms (one track).

DISK CONTROLLER/ I/O BOARD SPECIFICATIONS

- Controls up to four 8" drives.
- 1771A LSI (SD) floppy disk controller.
- Onboard data separator (IBM compatible).
- 2 Serial I/O ports
- Autoboot to disk system when system reset.
- 2716 PROM socket included for use in custom applications.
- Onboard crystal controlled.
- Onboard I/O baud rate generators to 9600 baud.
- Double-sided PC board (glass epoxy.)

DISK DRIVE CABINET/POWER SUPPLY

- Deluxe steel cabinet with individual power supply for maximum reliability and stability.

ORDER A COORDINATED EXPLORER/85 APPLICATIONS PAK!

Beginner's Pak (Save $26.00!) — Buy Level "A" (Terminal Version) with Monitor Source Listing and AP-1 5-amp Power Supply: (regular price $199.95), now at SPECIAL PRICE: **$169.95** plus post. & insur.

Experimenter's Pak II (Save $53.40!) — Buy Level "A" (Hex Keypad/Display Version) with Hex Keypad/Display, Intel 8085 User Manual, Level "A" Hex Monitor Source Listing, and AP-1 5-amp Power Supply: (regular price $279.35), all at SPECIAL PRICE: **$219.95** plus post. & insur.

Special Microsoft BASIC Pak (Save $103.00!) — Includes Level "A" (Terminal Version), Level "B", Level "D" (4k RAM), Level "E", 8k Microsoft in ROM, Intel 8085 User Manual, Level "A" Monitor Source Listing, and AP-1 5-amp Power Supply: (regular price $439.70), now yours at SPECIAL PRICE: **$329.95** plus post. & insur.

ADD A TERMINAL WITH CABINET, GET A FREE RF MODULATOR: Save over $114 at this SPECIAL PRICE: **$499.95** plus post. & insur.

Special 8" Disk Edition Explorer/85 (Save over $104!) — Includes disk-version Level "A", Level "B", two S-100 connectors and brackets, disk controller, 64k RAM, AP-1 5-amp power supply, Explorer/85 deluxe steel cabinet, cabinet fan, 8" SD/DD disk drive from famous CONTROL DATA CORP. (not a hobby brand!), drive cabinet with power supply, and drive cable set-up for two drives. This package includes everything but terminal and printers (see coupon for them). Regular price $1630.30, all yours in kit at SPECIAL PRICE: **$1499.95** plus post. & insur. Wired and tested, only **$1799.95.**

Special! Complete Business Software Pak (Save $625.00!) — Includes CP/M 2.0, Microsoft BASIC, General Ledger, Accounts Receivable, Accounts Payable, Payroll Package: (regular price $1325), yours now at SPECIAL PRICE: **$699.95.**

Please send the items checked below:

- ☐ **Explorer/85 Level "A" kit** (Terminal Version) . . . **$129.95** plus $3 post. & insur.
- ☐ **Explorer/85 Level "A" kit** (Hex Keypad/Display Version) . . . **$129.95** plus $3 post. & insur.
- ☐ **8k Microsoft BASIC** on cassette tape, **$64.95** postpaid.
- ☐ **8k Microsoft BASIC in ROM kit** (requires Levels "B", "D" and "E") . . . **$99.95** plus $2 post. & insur.
- ☐ **Level "B" (S-100) kit** . . . **$49.95** plus $2 post. & insur.
- ☐ **Level "C" (S-100 6-card expander) kit** . . . **$39.95** plus $2 post. & insur.
- ☐ **Level "D" (4k RAM) kit** . . . **$69.95** plus $2 post. & insur.
- ☐ **Level "E" (EPROM/ROM) kit** . . . **$5.95** plus 50¢ p&h.
- ☐ **Deluxe Steel Cabinet** for Explorer/85 . . . **$49.95** plus $3 post. & insur.
  - ☐ Fan For Cabinet . . . **$15.00** plus $1.50 post. & insur.
- ☐ **ASCII Keyboard/Computer Terminal kit:** features a full 128 character set, u&l case; full cursor control; 75 ohm video output; convertible to baudot output; selectable baud rate, RS232-C or 20 ma. I/O, 32 or 64 character by 16 line formats, and can be used with either a CRT monitor or a TV set (if you have an RF modulator) . . . **$149.95** plus $3.00 post. & insur.
  - ☐ **DeLuxe Steel Cabinet** for ASCII keyboard/terminal . . . **$19.95** plus $2.50 post. & insur.
- ☐ **New! Terminal/Monitor:** (See photo) Same features as above, except 12" monitor with keyboard and terminal is in deluxe single cabinet: kit . . . **$399.95** plus $7 post. & insur.
- ☐ **Hazeltine terminals:** Our prices too low to quote— **CALL US**
- ☐ **Lear-Sigler terminals/printers:** Our prices too low to quote: **CALL US**
- ☐ **Hex Keypad/Display kit** . . . **$69.95** plus $2 post. & insur.
- ☐ **AP-1 Power Supply Kit** ±8V @5 amps) in deluxe steel cabinet . . . **$39.95** plus $2 post. & insur.
- ☐ **Gold Plated S-100 Bus Connectors** . . . **$4.85** each, postpaid.
- ☐ **RF Modulator kit** (allows you to use your TV set as a monitor) . . . $8.95 **postpaid.**
- ☐ **16k RAM kit** (S-100 board expands to 64k) . . . **$199.95** plus $2 post. & insur.
- ☐ **32k RAM kit** . . . **$299.95** plus $2 post. & insur.
- ☐ **48k RAM kit** . . . **$399.95** plus $2 post. & insur.
- ☐ **64k RAM kit** . . . **$499.95** plus $2 post. & insur.
- ☐ **16k RAM Expansion kit** (to expand any of the above in 16k blocks up to 64k) . . . **$99.95** plus $2 post. & insur. each.
- ☐ **Intel 8085 cpu Users' Manual** . . . **$7.50** postpaid.
- ☐ **12" Video Monitor** (10MHz bandwidth) . . . **$139.95** plus $5 post. & insur.
- ☐ **Beginner's Pak** (see above) **$169.95** plus $4 post. & insur.
- ☐ **Experimenter's Pak** (see above) . . . **$219.95** plus $6 post. & insur.
- ☐ **Special Microsoft BASIC Pak Without Terminal** (see above) . . . **$329.95** plus $7 post. & insur.
- ☐ Same as above, plus **ASCII Keyboard Terminal With Cabinet, Get Free RF Modulator** (see above) . . . **$499.95** plus $10 post. & insur.
- ☐ **Special 8" Disk Edition Explorer/85** (see above) . . . **$1499.95** plus $26 post. & insur.
  - ☐ **Wired & Tested** . . . **$1799.95** plus $26 post. & insur.
- ☐ **Extra 8" CDC Floppy Drives** . . . **$499.95** plus $12 post. & insur.
  - ☐ **Cabinet & Power Supply For Drive** . . . **$69.95** plus $3 post. & insur.
- ☐ **Drive Cable Set-up For Two Drives** . . . **$25** plus $1.50 post. & insur.
- ☐ **Disk Controller Board With I/O Ports** . . . **$199.95** plus $2 post. & insur.
- ☐ **Special: Complete Business Software Pak** (see above) . . . **$699.96** postpaid.
  - SOLD SEPARATELY:
  - ☐ **CP/M 1.4** . . . **$100** postpaid.
  - ☐ **CP/M 2.0** . . . **$150** postpaid.
  - ☐ **Microsoft BASIC** . . . **$325** postpaid.
- ☐ **Intel 8085 cpu User Manual** . . . $7.50 **postpaid.**
- ☐ **Level "A" Monitor Source Listing** . . . **$25** postpaid.

Continental U.S.A. Credit Card Buyers Outside Connecticut

CALL TOLL FREE: 800-243-7428

To Order From Connecticut Or For Technical Assistance, call (203) 354-9375

Total Enclosed (Conn res. add sales tax) $ ______

Paid By:

☐ Personal Check ☐ Cashier's Check/Money Order

☐ VISA ☐ Master Charge (Bank No. _ _ _ _)

Acct. No. ______________ Exp. Date ______

Signature ______________

Print Name ______________

Address ______________

City ______________

State ______________ Zip ______

NETRONICS Research & Development Ltd.
333 Litchfield Road, New Milford, CT 06776

most valuable way—namely, in the way that yields the greatest public benefits. Just as raising a crop of corn and grazing cattle are incompatible uses of the same plot of land, so too may the operation of a computing device and the transmission of television signals present incompatible uses of the electromagnetic spectrum. The FCC, therefore, is forced to balance the demands placed on electromagnetic spectrum usage by American businesses and consumers: the difficulty arises in determining which use will yield the greatest public benefits.

Consider, for example, the following possible public-cost/benefit scenarios involving computing devices and communications services:

- A suspected criminal is being pursued by police through winding city streets. Several patrol cars begin converging on the suspect from different directions as information on the suspect's location and movement is relayed over the police radio band. Suddenly, the suspect makes an abrupt turn through the parking lot of a cocktail lounge. Before the pursuing car can communicate the suspect's sudden movement, however, interference crackles over the police band, drowning out all communications for several seconds. When the band finally clears, the police learn that they have lost track of the fleeing suspect. Later, the police investigate the cause of the interference on their restricted band and learn that one of the coin-operated video games in the cocktail lounge was the source of the interfering radio frequencies.
- An airplane pilot finds himself caught in bad weather and is forced to make an "instrument" landing. As the pilot approaches the airfield, he asks his copilot to render a quick computation to better gauge their position. The control tower, which has the plane on radar, warns the pilot of an approaching larger aircraft. Suddenly, before the tower's automatic collision-avoidance instructions are received, interference drowns out the radio channel. While waiting for the channel to clear, the pilot nearly collides with a commercial airliner but manages to land safely. The FAA (Federal Aviation Administration) later conducts an investigation and learns that the electronic calculator used by the copilot emitted the RFI that caused the interference on the restricted aeronautical-frequency band.
- A young mathematics student receives a personal computer for his fifteenth birthday. Shortly thereafter his entire family begins to use the computer for various applications: the father does tax and financial planning for his insurance clients; the mother stores cooking recipes and addresses and telephone numbers of friends and relatives; and the younger brother plays electronic video games. Soon, even the family's home-security and energy-control systems are being run by the computer. Meanwhile a neighbor complains to an FCC field office that he has been experiencing interference each evening over one of his local television channels. The field office investigates and learns that the personal computer is the source of the RFI. The family is told to correct their computer or discontinue its use. Since the

> manufacturer's warranty does not cover RFI defects, the family is forced to undertake expensive corrective measures of their own.

While these examples may seem a little contrived, in fact, each concerns a theoretical situation with which the FCC is concerned.

Moreover, in every case brought to the FCC's attention involving RFI from computers, the FCC has routinely decided that radiation from such devices is a less valuable use of the spectrum than the radio-communication services which might be interfered with. Stated another way, it is current FCC policy for computer equipment manufacturers to bear the associated costs of their new and beneficial technology.

Computing Device Interference

Computers and other similar devices emit potentially harmful radio-frequency signals. Inside a computer, very rapid electrical signals and pulses are generated and used to regulate sequences of events and to carry out the control and logic functions of the computer. These rapid electrical pulses produce high-frequency emissions that "float" around inside the cabinet of the computer. Unless this energy is somehow contained or filtered, it is radiated into space to be picked up by radio or television receivers.

Computers have been reported to cause harmful interference to almost all radio services, particularly those services below 200 MHz, including police, aeronautical, and broadcast services. Several factors that have contributed to the recent increase in computer-interference complaints include:

- the proliferation of digital electronic equipment in both businesses and homes;
- the development of higher-speed computers, which require designers to contend with problems of radio-frequency emission never before experienced;
- the increased replacement of steel cabinets with plastic cabinets, which provide little or no RFI shielding.

To the extent that computing devices are harmful in terms of their potential for generating RFI, and because private mediation between interfering uses is considered highly unlikely, the FCC becomes the final arbiter of spectrum interference.

Part 15 of the Commission's Rules specifically addresses these concerns by setting forth various technical and administrative specifications for all devices that generate or use radio-frequency energy. Computer and other digital devices not intended to radiate RFI are defined as *restricted-radiation devices.* Until very recently, however, restricted-radiation devices were subject to technical performance standards first drafted by the FCC in 1938. In further complication of matters, under these 40-year-old rules, personal computers are subject to vastly different technical standards depending on whether they contain their own video displays or connect to an external television set.

Three years ago the FCC initiated a rule-making procedure to modernize its Part 15 rules and to render them more workable and nondiscriminatory in our evolving electronic society. The proceeding was recently concluded with the adoption of new regulations that will affect *all* computer manufacturers. Hardest hit,

however, will be the personal-computer industry.

FCC Classification of Computing Devices

In order to establish RFI standards that are appropriate for a given computer's actual harm-causing potential, the Commission has classified all computing devices under a binary scheme: Class A devices are defined as computing devices used in commercial environments, and Class B devices are defined as those used in a residential environment or widely marketed to the public.

The basis for this dual classification scheme is rooted in the theory that Class B (consumer) devices are located in closer proximity to radio, television, and (in many cases) land-mobile radio services and thus have a higher potential for causing interference than do Class A (commercial) devices. Additionally, the Commission has reasoned that consumer products usually do not contain the technical sophistication found in commercial equipment, nor do they receive the same level of preventive maintenance.

In recognition of these important differences, between consumer and commercial products, the FCC has imposed technical standards on consumer equipment that are *ten times* more stringent than those standards imposed on commercial equipment. More importantly perhaps, the Commission is requiring manufacturers of consumer devices to *register* their products with the FCC *by January 1, 1981* or cease all marketing; no similar rule applies to manufacturers of commercial computing equipment.

(In addition, the FCC rules further distinguish between Class B "personal computing" devices that contain their own video displays and those that connect to a standard home television receiver (so-called Class I TV devices), with the latter being subject to somewhat stricter rules. Such distinctions between personal-computing devices should soon disappear, pending the successful completion of an on-going rulemaking in this area.)

The Regulatory Scheme for Computing Equipment

The FCC's regulatory scheme for computing devices consists of both technical standards and administrative procedures. The technical standards are designed to minimize the likelihood that computing devices will cause interference with any FCC-authorized communications services. Therefore, standards for radiation as well as conduction (ie: through a building's wiring) limit the amount of radio frequency that computing devices will be permitted to emanate during their normal operation.

The administrative procedures adopted by the FCC are intended to ensure that manufacturers comply with the appropriate technical standards; these procedures also apprise the users of each class of equipment of its interference potential and what to do in case of technical failure. Most important, however, are the compliance deadlines that manufacturers must meet in order to continue (or begin) advertising and marketing their computing equipment. As explained more fully below, the rules differ substantially between commercial and consumer equipment, with the latter being subject to more stringent requirements.

Class Definition Distinctions

The FCC defines a "computing device" to be any electronic system that generates timing signals or pulses in excess of 10,000 cycles per second (10 kHz) *and* uses digital techniques. This definition includes, among other things, digital telephone equipment or any device that generates radio frequencies for the purpose of performing data-processing functions such as "electronic computations, operations, transformations, recording, filing, sorting, storage, retrieval, or transfer." The Commission notes that computer terminals and peripherals also fall within this definition but that other components and subassemblies do not.

Class A devices are further defined as any computing devices that are marketed for use in a commercial, industrial, or business environment. Class B devices are defined to be computing devices *marketed for use* in a residential environment in spite of their potential use in commercial environments. Examples of Class B devices are electronic games, personal computers, calculators, and similar electronic devices marketed to the general public. Temporarily exempt-

THE OASIS RECIPE FOR QUALITY APPLICATION SOFTWARE.

Happy customers are fast making Single & Multi-User OASIS recognized as *the* super system software. BUT, system software is only as good as the applications it runs. And that's where OASIS really cooks.

Application software developers particularly like OASIS because it lets them blend unique performance features with their own products—in other words, build better software. Security features like User Accounting with Logon, Password and Privilege Level; File and Automatic Record Locking; Private, Shared and Public Files. Speed and convenience of Keyed Index (ISAM) Files. Economy from Compiled Re-Entrant BASIC that makes multi-user systems practical on as little as 64K memory. And lots more.

Because OASIS has better development tools—and more of them—creating very sophisticated software is possible, practical, easier, faster. Just one example: BASIC that is an Interpreter and Compiler with Debugger and Editor. If you do your own development, you'll really appreciate these kinds of features. For software professionals, they make providing superior products much more cost attractive.

Add all the ingredients together and, whether you do it yourself or buy it off the shelf, the pay-off is a wide selection of top-performing, top-quality application software that does more so you do less.

OASIS; Single or Multi-User with a sizzling array of features and tools; almost unlimited software possibilities *(and application software for Single-User OASIS is Multi-User compatible);* the most extensive documentation in the industry—indeed, you get a lot to like. And *that's* put OASIS System Software* among the hottest products on the market.

Drop us a line today for a complete, free Application Software Directory. And see your OASIS Distributor, or send the coupon direct, to get the products you want. Try us. We believe you'll savor the OASIS recipe.

* For Z80 based computers.

OASIS IS AVAILABLE FOR

SYSTEMS: Altos; Compucorp; Cromemco; Delta Products; Digital Group; Digital Microsystems; Dynabyte; Godbout; IBC; Index; Intersystems; North Star; Onyx; SD Systems; TRS 80 Mod II; Vector Graphic; Vorimex.

CONTROLLERS: Bell Controls; Cameo; Corvus; Konan; Micromation; Micropolis; Tarbell; Teletek; Thinkertoys; X Comp.

APPLICATION SOFTWARE AVAILABLE FOR OASIS:

Accounts Payable; Accounts Receivable; General Ledger; Mail List Pak; Order Entry/Inventory Control; Inventory Tracking Pak; Word Processors.

Architects & Pro Designers Timekeeping & Job Cost Analysis; Cable TV Subscriber Billing Sys; Construction Mgt Pak; Construction Pak; Contractors Tracking Pak; Distributors Pak; Dental Office Mgt Pak; Medical Billing Sys; Pharmacy Prescription Processing with A/R; Management Analysis Pak; Real Estate Office Mgt; Restaurant Pak; Sewer & Water Utility Info Pak.

Bisyncronous Communication Pak; 2780/3780/3270 Emulators; File & Screen Mgr with Report Generator; Full Network Data Base Mgt Sys; Game Pak; Hierarchical Data Base Mgt Sys; Radlogs (Radio Station Logs/Schedules/Programming/Billing with A/R, A/P, G/L.

THESE ITEMS ARE NOT AVAILABLE DIRECT FROM PHASE ONE SYSTEMS, INC. —please write for ordering instructions and complete, free Application Software Directory. If you have items you would like listed in the Directory, send us complete information.)



MAKES MICROS RUN LIKE MINIS

PLEASE SEND ME:

Product	Price with Manual	Manual Only
OPERATING SYSTEM (Includes: EXEC Language; File Management; User Accounting; Device Drivers; Print Spooler; General Text Editor; etc.) SINGLE-USER / MULTI-USER	$150 / 350	$17.50 / 17.50
BASIC COMPILER/INTERPRETER/DEBUGGER	100	15.00
RE-ENTRANT BASIC COMPILER/INTERPRETER/DEBUGGER	150	15.00
DEVELOPMENT PACKAGE (Macro Assembler; Linkage Editor; Debugger)	150	25.00
TEXT EDITOR & SCRIPT PROCESSOR	150	15.00
DIAGNOSTIC & CONVERSION UTILITIES (Memory Test; Assembly Language; Converters; File Recovery; Disk Test; File Copy from other OS; etc.)	100	15.00
COMMUNICATIONS PACKAGE (Terminal Emulator; File Send & Receive)	100	15.00
PACKAGE PRICE (All of Above) SINGLE-USER / MULTI-USER	500 / 850	60.00 / 60.00
FILE SORT	100	15.00
COBOL-ANSI '74	750	35.00

Order OASIS from:

Phase One Systems, Inc.
7700 Edgewater Drive, Suite 830
Oakland, CA 94621
Telephone (415) 562-8085
TWX 910-366-7139

NAME________
STREET (NO BOX #)________
CITY________
STATE________ ZIP________
AMOUNT $________
(Attach system description; add $3 for shipping; California residents add sales tax)
☐ Check enclosed ☐ VISA
☐ UPS C.O.D. ☐ Mastercharge
Card Number________
Expiration Date________
Signature________

ed (pending further rulemaking by the FCC) from the specific Class B technical and administrative requirements are microprocessors utilized in transportation vehicles, home appliances, test equipment, and electronic power or control systems utilized in industrial plants.

Compliance Verification Procedures

Class A device manufacturers are required, prior to marketing, to *verify* that their devices meet the technical provisions set forth in the FCC's rules. In contrast, manufacturers of most Class B devices on the market (eg: electronic video games and personal computers) must *certify* to the Commission that their devices comply. Herein lies the heavy burden to be shouldered by the personal computing industry under the FCC regulations. (For, if any lesson is to be learned from the FCC's "Part 68 Program" for certification of telephone devices, it is that federal regulations of this type are both costly and time consuming for manufacturers.)

(1a) RADIATION - Maximum field-strength limits

	Frequency (MHz)	Distance (meters)	Field Strength (μV/m)
Class A	30 to 88	30	30
	88 to 216	30	50
	216 to 1000	30	70
Class B	30 to 88	3	100
	88 to 216	3	150
	216 to 1000	3	200

(1b) CONDUCTION - Maximum voltage levels

	Frequency (MHz)	Maximum RF Line Voltage (μV)
Class A	0.45 to 1.6	1000
	1.6 to 30	3000
Class B	0.45 to 30	250

Table 1: *Radiation and conduction standards for computing devices. Table 1a sets the maximum permissible level of radiated radio-frequency emissions for both Class A (commercial) and Class B (consumer) devices. Table 1b does the same for conducted emissions impressed on the electrical-power network.*

Verification (for commercial devices) is basically an approval procedure based on the honor system, whereby a manufacturer tests his equipment to verify to the public that it complies with the appropriate technical standards. Although no FCC notification is imposed, manufacturers are still required to maintain records of their testing procedures and results.

By comparison, certification (for consumer devices) is an arduous equipment-authorization procedure which requires manufacturers to test their product for compliance and submit the test information to the FCC along with a completed application (FCC Form 731), photographs, and fees. After the FCC reviews the submissions, a certification number is issued for the tested equipment; the manufacturer must affix this number to every model thereafter imported, advertised, or marketed. Any subsequent change in the circuitry or operation requires that the equipment be recertified to the FCC.

Due to their high potential for causing RFI, the Commission has determined that only the following devices must be certified: electronic games, including coin-operated video games (but excluding handheld games that do not use a television receiver for display); personal computers (excluding digital clocks, desktop calculators, and handheld calculators); and peripherals and terminals capable of being attached to a personal computer. All other Class B devices need merely be verified by manufacturers prior to their marketing.

Technical Standards

The technical standards imposed by the new rules are designed to provide a "reasonable degree" of protection for radio and television receivers. Since unwanted interference from computing devices can result from radiated as well as conducted RFI, the standards regulate both types of emission. (See table 1.) Radiation testing requires manufacturers to measure the radio-frequency emanations at specified frequencies and distances from their equipment to ensure that certain maximum energy levels are not exceeded. Conduction testing is designed to ensure that equipment will not impart more than a maximum level of energy over a specified frequency range into the electrical-power network. [*For example, this restriction will apply to devices that use house wiring to remotely control appliances....***GW**] (The actual equipment-test procedures to be used by manufacturers are the subject of a current rulemaking before the FCC. Until final rules are issued, the Commission has approved certain conventional industry test procedures.)

Together, both tests protect against interference frequencies as low as 450 kHz (just below AM radio) to frequencies as high as 1000 MHz (above UHF television signals). As stated previously, the standards for Class B equipment are ten times more stringent than those for Class A.

Labeling and User Information

Complex rules notifying users of their computing devices' potential (or lack thereof) for interference with radio communications and spelling out corrective action to be taken are key aspects of the FCC's administrative regulations. In essence, *all* computing devices will require some type of labeling or warning after January 1, 1981; however, these regulations will vary depending on the classification of the device as well as the device's mandatory-compliance date. All Class A equipment (unless certified under the Class B standards) must warn users that its operation in a residential environment may cause interference for which the user will be held accountable.

TERRIFIC TRIO: Z80, OASIS, MAROT.

A superior operating system and top application software bring out the best in a microcomputer. That's why Marot offers the OASIS* Operating System and compatible software for owners of Z80 based micros. They make a terrific trio.

1 Z80 MICROS —great machines. Tandy's TRS-80 MOD II® with DMA, bank select possibilities and nationwide service. Altos. Cromemco. Horizon. And many others. Great machines—but it takes a great operating system to tap their full potential.

2 ENTER OASIS —available from Marot. OASIS is fast emerging as *the* operating system for Z80 commercial applications and serious programmers. Why?...rapid formating and back-up of diskettes; efficient disk utilization; excellent line editor and document processor for file management and textwriting; user accounting with logon, password, privilege level and use accounting; machine independence of programs, data and text files; sequential, direct and keyed index (ISAM) files; interpreted and compiled BASIC; COBOL-ANSI '74; single and multi-user versions; and more. No wonder pros say 'OASIS makes micros run like minis!'

3 APPLICATION SOFTWARE —available from Marot. OASIS is your active, invisible partner supporting these excellent, ready-to-run products:

Magic Wand.® The wordprocessor combining the ease of screen editing with micro power.

HDBS.** For data management needs restricted to hierarchical tree structure and fixed length records.

MDBS.** Handles full network CODASYL oriented data structures and variable length records.

ABS.*** Quality office management systems—accounts receivable and payable, general ledger, etc.—the total interacting, user-oriented business package. Written in COBOL; available with source code.

A Law package. And ready soon: complete medical management, real estate, restaurant, pharmacy, management analysis packages, and others.

Marot and its Dealers offer OASIS and many professional software products to individuals, OEMs and dealers. Licensing arrangements are also available. Just call or write and start your own terrific trio.

PLEASE SEND ME:

(Circle what you would like and send order with payment to the address shown below.)

☐ SEND COMPLETE INFORMATION

Product	Price
MAGIC WAND®	$400
ABS ACCOUNTING (call or write)	
MDBS, full network	$900
HDBS	300
Report Generator, Query System	300
Primer	10
(Other options available)	

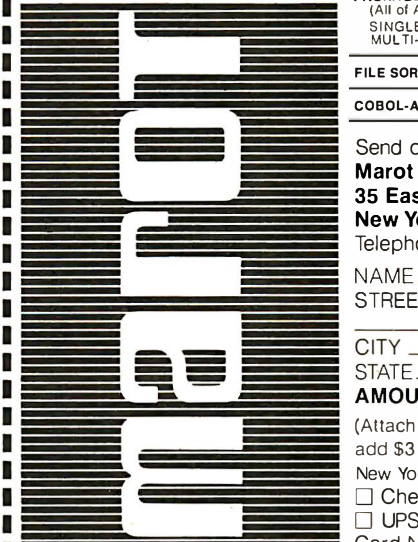
Magic Wand, MDBS and HDBS are available for several operating systems.

*OASIS is the trademark of Phase One Systems, Inc
**HDBS and MDBS are produced by Micro Data Base Systems, Inc
***American Business Systems, Inc

TRS-80 is the registered trademark of the Tandy Corporation

Magic Wand is the registered trademark of Small Business Systems, Inc

Product OASIS	Price with Manual	Price Manual Only
OPERATING SYSTEM (Includes: EXEC Language; File Management; User Accounting; Device Drivers; Print Spooler; General Text Editor; etc.) SINGLE-USER	$150	$17.50
MULTI-USER	350	17.50
BASIC COMPILER/ INTERPRETER/DEBUGGER	100	15.00
RE-ENTRANT BASIC COMPILER/INTERPRETER/ DEBUGGER	150	15.00
DEVELOPMENT PACKAGE (Macro Assembler; Linkage Editor; Debugger)	150	25.00
TEXT EDITOR & SCRIPT PROCESSOR	150	15.00
DIAGNOSTIC & CONVERSION UTILITIES (Memory Test; Assembly Language; Converters; File Recovery; Disk Test; File Copy from other OS; etc.)	100	15.00
COMMUNICATIONS PACKAGE (Terminal Emulator; File Send & Receive)	100	15.00
PACKAGE PRICE (All of Above) SINGLE-USER	500	60.00
MULTI-USER	850	60.00
FILE SORT	100	15.00
COBOL-ANSI '74	750	35.00



MAROT SOFTWARE SYSTEMS
YOUR EASTERN SOURCE

Send order to:
Marot Software Systems, Inc.
35 East 85th Street
New York City, NY 10028
Telephone (212) 534-5499

NAME ______
STREET (NO BOX #) ______
______
CITY ______
STATE ______ ZIP ______
AMOUNT $ ______

(Attach system description; add $3 for shipping; New York residents add sales tax.)

☐ Check enclosed ☐ VISA
☐ UPS C.O.D. ☐ Mastercharge

Card Number ______
Expiration Date ______
Signature ______

Mandatory-Compliance Dates

With regard to the new rules' effective dates, here too, the Commission's regulations are complicated and confusing. Originally, the Commission proposed a single deadline, July 1, 1980, after which all manufacturers of computing devices would have to comply with the appropriate rules or cease marketing their equipment. However, it soon became obvious to the Commission that several factors made a unified effective date impractical; these factors include the apparent lack of trained personnel to perform the necessary tests, the large number of devices in production that would have to be tested, and the shortage of emission-suppression components.

Upon reconsideration, therefore, the FCC adopted the following schedule of mandatory effective dates for compliance with its Part 15 rules (see table 2):

- Personal computers and other devices requiring certification (eg: video games, peripherals, and terminals) must meet the Class B standards by January 1, 1981.
- All other computing devices (Classes A and B) must comply with the appropriate device standards if *first manufactured* after October 1, 1981.
- If such (noncertificated) devices, however, are placed into production before October 1, 1981, compliance will not be required (for subsequently produced devices) until October 1, 1983.

Any device failing to meet these mandatory-compliance dates cannot lawfully be marketed, imported, or advertised for sale in the United States.

Special Rules for Subassemblies and Peripherals

Components and subassemblies of computing devices are not required to comply independently with the Commission's technical standards. In addition, peripherals supplied as part of a computing device do not need to be considered separately. Nevertheless, because all *end products* must comply, systems vendors and integrators can be expected to pressure their components suppliers into indirect compliance with these new rules.

On the other hand, peripherals marketed independently from their associated computing devices must comply directly with all technical and administrative standards. Peripherals marketed as part of any personal computing systems (which are in the Class B certified category) therefore must be certificated; all other peripherals (in the Class B noncertified and Class A categories) need merely be verified. In addition, peripherals sold separately from their computing systems also must be individually labeled.

Enforcement of Computing Device Rules

Lest there be any question as to the Commission's experience or commitment in enforcing its interference regulations as they pertain to the mass distribution of consumer devices, you need only recall the regula-

Compliance Date	Equipment Class
January 1, 1981	All Class B devices requiring certification (personal computers, electronic video games, and peripherals and terminals capable of being attached to personal computers) *manufactured* after this date.
October 1, 1981	All Class A devices and Class B devices not requiring certification which are *first placed into production* after this date.
October 1, 1983	All Class A devices and Class B devices not requiring certification which are *manufactured* after this date, regardless of when first placed into production.

Any device failing to meet these mandatory compliance dates cannot lawfully be marketed, imported, or advertised for sale in the US.

Table 2: *Dates of mandatory compliance for computing devices.*

Smart shopping

Your Hazeltine distributor has all the terminals you need.

You can save time by taking all your TTY terminal needs to one source—your local Hazeltine distributor. Right in your neighborhood, your distributor offers the same quality, the same service and the same comprehensive warranty program that you would get by contacting Hazeltine directly.

The Hazeltine distributor can give you easy access to a broad selection of Hazeltine products, including the economical Hazeltine 1400/1500 series of conversational and editing terminals, the high performance Modular One family, and—soon—the new Hazeltine Executive 80™ line of sophisticated smart terminals. An experienced sales professional, your local distributor is ready to provide full product and application support.

Most important, each of our authorized distributors has Hazeltine's full support. You will find that Hazeltine's entire field and factory organization supports the distributor when you need delivery, warranty service, or even just the answer to a question.

Be a smart shopper. Call your nearest Hazeltine distributor—part of our winning team for the eighties.

Hazeltine Corporation,
Computer Terminal Equipment,
Greenlawn, NY 11740.
(516) 549-8800 Telex: 96-1435

Hazeltine and the Pursuit of Excellence



Hazeltir
1400 Se
performanc
economy te
Hazeltin
1500 Serie
performance in
economy termin

tory crackdown that accompanied the Citizens Band radio craze of a few years ago. There, the Commission revealed that it had adequate power over both manufacturers and retailers to prevent users from gaining access to equipment that was improperly engineered or tested.

The FCC can enforce its rules through either civil or criminal proceedings. For simple violations of any rules, the FCC has the power to issue cease-and-desist orders (ie: administrative injunctions) commanding the violator to comply with the rules or possibly face severe consequences. The severe consequences may be in the form of court-ordered injunctions or, in the case of willful violations, felony prosecutions with possible fines and prison terms of up to 2 years. Needless to say, criminal sanctions are rarely imposed by the Commission.

The FCC is hoping, rather, for manufacturers and vendors to comply willingly with its rules to avoid developing a reputation for selling customer equipment that results in widespread interference. Should large-scale noncompliance result, however, more vigorous standards and more troublesome equipment-authorization procedures could very likely be adopted by the Commission and imposed on the entire industry.

Conclusion

As with any FCC rulemaking that involves evolutionary consumer products, the Commission's activities to date may reveal only the tip of the iceberg. The protracted FCC proceedings involving telephone-equipment registration bear strong witness to this observation. New microprocessor-based devices may create unforeseen RFI problems not addressed in the new rules, changing work patterns will slowly blur the environmental distinctions between the home and office, and evolving communication services will continue to place additional demands on spectrum usage. Indeed, the Commission's fundamental assumption for its classification of computing devices (ie: proximity to RF receivers) is already starting to erode as radio receivers become increasingly utilized in commercial environments for the provision of Teletext and direct (rooftop) broadcast satellite services.

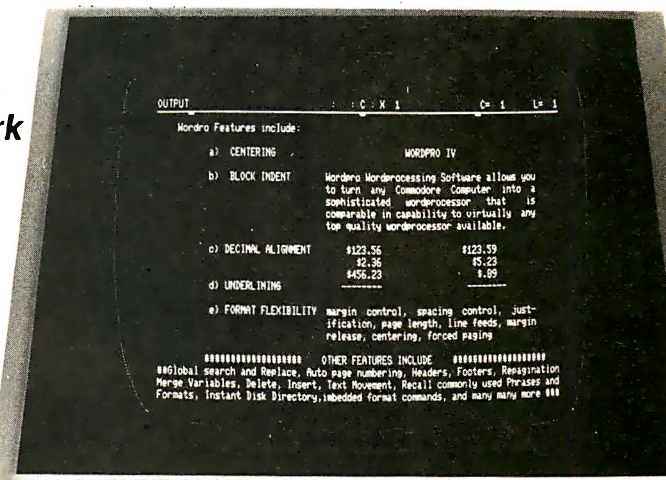
With new rules come new costs—whether they be costs of equipment redesign, costs of RFI-suppression components, or costs of testing, labeling, and FCC-certification delays.

The FCC is currently in the midst of a rulemaking proceeding to develop the Part 15 equipment-testing procedures. Slated for possible future rule amendments are handheld calculators, home appliances, microprocessor-based transportation systems, and other similar devices. Manufacturers of these types of equipment, therefore, should adapt to the idea that the FCC represents a cost of doing business that cannot be avoided—from now on.

Incidentally, the FCC's rules seek only to prevent interference between computing devices and (FCC-approved) communications *services*. Interference between incompatible *devices* utilized in the home (eg: wireless intercoms, burglar- and fire-detection systems, wireless switches, etc) is probably beyond the FCC's jurisdiction. Thus, it will be up to the industry itself to resolve among its own members—possibly through the newly-formed Home Bus Standards Association—these emerging interference issues.■

WordPro™

"WordPro is the most sophisticated Word Processing Software package available for the Commodore Computer line."



Actual Photograph of WordPro on CBM Model 8032

Solve Your Paperwork Problem... Let WordPro Software Do The Work

Using standard typing methods, hundreds of valuable hours are spent erasing, revising, and retyping letters and documents as you work towards a final draft copy. The second, third, or fourth drafts take just as long to type as the first!

With WordPro word processing software you can transform your Commodore computer into a "state of the art" word processing machine with sophisticated word processing features at an affordable price.

There are four versions of WordPro, ranging from the simple to the sophisticated. WordPro 1 on cassette will give computer enthusiasts a full range of text editing capabilities with cassette file storage. WordPro 2 is disk based and allows fast and easy file handling and manipulation. WordPro 3 was designed for professionals and contains the many features required in a business environment such as global search and replace, headers, footers, decimal tabulation, repagination, merging capabilities, and much, much more. WordPro 4 is our best. WordPro 4 runs on the new Commodore 8032, 80-column display computer. WordPro 4 has all the features of WordPro 3, plus additional features usually found only on the most sophisticated and expensive word processing equipment.

WordPro is a new breed of word processing software. Powerful, sophisticated, and easy to use, WordPro was field-tested by dozens of attorneys and commercial customers during 1979. WordPro is now installed and is saving its owners valuable time and money in hundreds of offices nationwide.

WordPro was designed with the user in mind. WordPro's unique "STATUS LINE" constantly interacts with the user by displaying the status of the system. Editing, storing documents, recalling letters, even the most sophisticated comands, are accomplished by a few, easy to remember, keystrokes.

You may find that WordPro alone is reason enough to own a computer.

WordPro can be found at most Commodore dealers worldwide. Call us for the number of the dealer nearest you. If you cannot locate a stocking WordPro dealer you may place an order with Professional Software via check or VISA/MasterCharge.

The many features of WordPro 1 - 4:

WordPro 1 - Cassette based • Status line • Test Editing • Insert/Delete • Screen Scroll Auto Repeat • String Search • Erase Functions • Link Files • Margin Controls • Tab Functions • Justification • Page Length

WordPro 2 - Most WordPro 1 Functions Plus + Disk Based • Paragraph Indent • Centering • Text Transfer • Hyphenation • Appending • Margin Release • Variable Blocks (Form Letters) • Multiple Copies • Automatic Disk Commands • Complete Disk File Handling

WordPro 3 - Commercial Disk Version for 40 Columns • WordPro 2 Functions Plus + Global Functions (Search/Replace/Copy) • Merging Disk File Linkage • 10 or 12 Pitch • Repagination • Duplicate Lines • Auto Delete Word/Sentence/Range • Numeric Mode • Underlining • Continuous Print • Headers/Footers • Auto Page Numbering • Proportional Justification • Forced Paging • Non-Print Comments • BASIC Language File Compatibility

WordPro 4 - Commercial Disk Version for 80 Columns • WordPro 3 Functions Plus + Displays and Formats Text to Screen for Review

WordPro 1 — For all 8K RAM units. Requires C2N Peripheral/integrated cassette drive - **$29.95**

WordPro 2 — For all 16K RAM units with 40 column screen. Requires 2040 disk drive - **$99.95**

WordPro 3 — For all 32K RAM units with 40 column screen. Requires 2040 disk drive - **$199.95**

WordPro 4 — For Model 8032 with 80 column screen. Requires 2040 or 8050 disk drive - **$299.95**

All four versions of WordPro are written in 6502 machine code.



Professional Software Inc.

166 Crescent Rd., Needham, MA 02194

(617) 444-5224

Circle 116 on inquiry card.

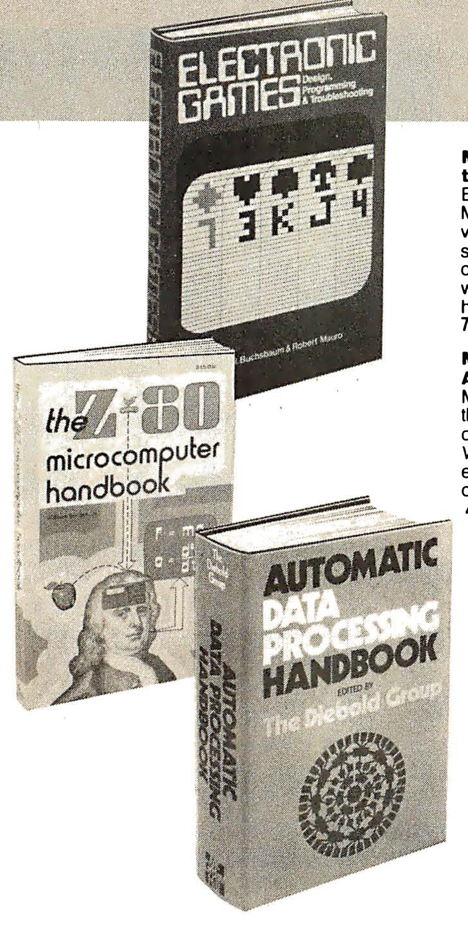
WordPro Dealer Inquires Invited

WordPro was developed by Steve Punter of Pro-Micro Software Ltd., and is marketed exclusively by Professional Software Inc.

WordPro is a registered trademark of Professional Software Inc. CBM is a registered trademark of Commodore Business Machines.

BUY ONE of these great professional books

when you join the

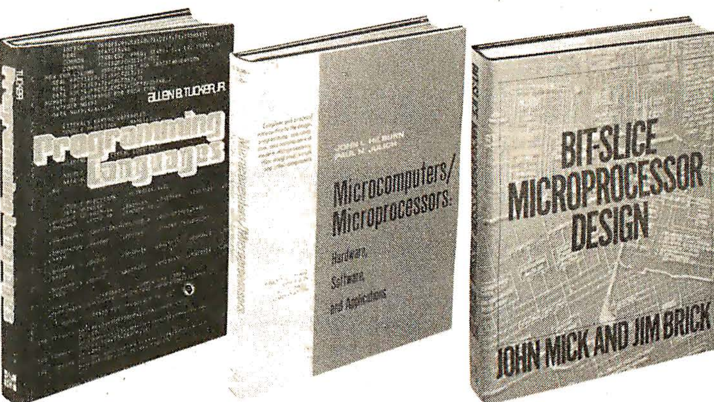


MINICOMPUTER SYSTEMS, Organization, Programming, and Applications. By Richard H. Eckhouse, Jr. and L. Robert Morris. *2nd Ed., 491 pp., illus.* Updated, revised, and expanded, this is a book for every systems programmer, systems designer, computer scientist, and application specialist who wants to know more about microcomputer hardware, software, and design.
787/026 Pub Pr., $21.95 Club Pr., $17.75

MICROELECTRONICS: Digital and Analog Circuits and Systems. By Jacob Millman. *801 pp., 700 illus.* Exciting news for the thousands of engineers who want a thorough refresher and updating on today's ICs. Will be welcomed by both digital and analog electronics engineers at every level of proficiency.
423/27X Pub. Pr., $28.95 Club Pr., $22.50

AUTOMATIC DATA PROCESSING HANDBOOK. Edited by The Diebold Group. *976 pp., 269 illus.* Written by a staff of internationally recognized authorities on ADP, this comprehensive handbook explains systems, programming and the languages, communications processes, and the design and installation of today's computers.
168/075 Pub Pr., $44.95 Club Pr., $31.50

THE Z-80 MICROCOMPUTER HANDBOOK. By William Barden, Jr. *304 pp., illus., paperbound.* This book gives you the entire "state of the art" in microcomputer technology today. Arranged in three convenient and logically developed sections, the book discusses architecture and interface signals, then powerful interrupt sequences of Z-80 and interfacing examples of I/O memory devices.
784/914 Pub Pr., $8.95 Club Pr., $7.60



BE SURE TO CONSIDER THESE IMPORTANT TITLES AS WELL—

APPLYING MICROPROCESSORS, New Hardware, Software, and Applications. Edited by L. Altman & S. E. Scrupski
191/603 Pub. Pr., $23.50 Club Pr., $18.95

57 PRACTICAL PROGRAMS & GAMES IN BASIC. By K. Tracton
784/957 Pub. Pr., $10.95 Club Pr., $9.30

MICROPROCESSOR ARCHITECTURE AND PROGRAMMING. By W. F. Leahy
784/612 Pub. Pr., $24.50 Club Pr., $18.50

16 BIT MICROPROCCESSOR ARCHITECTURE. By T. Dollhoff
582003-X Pub. Pr., $24.95 Club Pr., $19.95

THE BASIC COOKBOOK. By K. Tracton
786/615 Pub. Pr., $7.95 Club Pr., $6.75

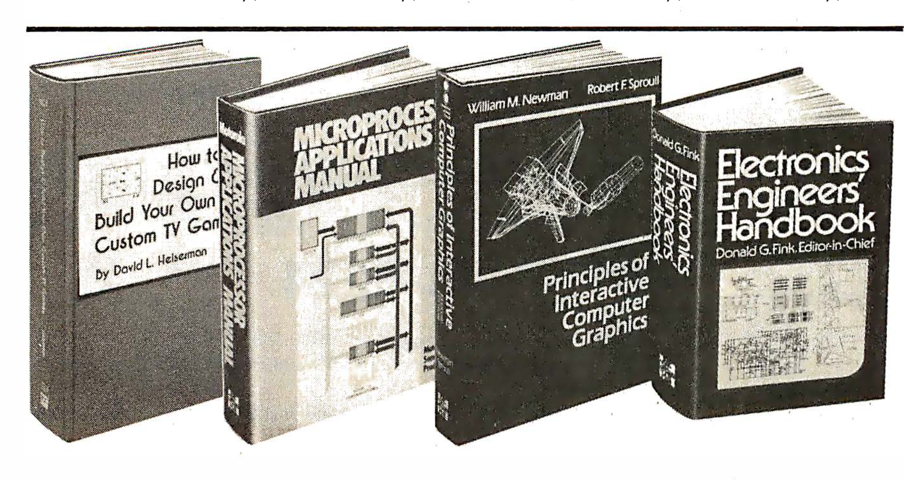
MICROPROCESSOR PROGRAMMING FOR COMPUTER HOBBYISTS. by N. Graham
783/56X Pub. Pr., $12.95 Club Pr., $10.95

DISTRIBUTED MICRO/MINICOMPUTER SYSTEMS. By C. Weitzman
789/622 Pub. Pr., $22.50 Club Pr., $18.25

HOME COMPUTER PROGRAMS. By J. W. Tudell, Jr. & M. Landberg
787/042 Pub. Pr., $8.95 Club Pr., $7.60

FUNDAMENTALS OF COMPUTER ALGORITHMS. by E. Horowitz & S. Sahni
786/380 Pub. Pr., $22.95 Club Pr., $18.25

ELECTRONICS DICTIONARY. By J. Markus
404/313 Pub. Pr., $24.50 Club Pr., $19.50



BIT-SLICE MICROPROCESSOR DESIGN. By John Mick and Jim Brick. *398 pp.* All in one place—the crucial information you've been needing about the 2900 family of bit-slice microprocessor components. This remarkable "first" designs right before your eyes not just one but *two* complete 16-bit machines!
417/814 Pub. Pr., $18.50 Club Pr., $14.50

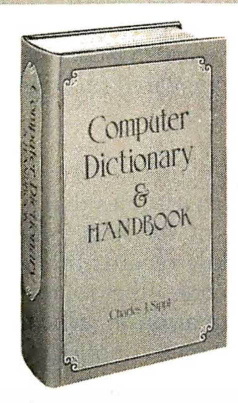
PRINTED CIRCUITS HANDBOOK. Edited by C. F. Coombs, Jr. *2nd Ed., 634 pp., 595 illus.* Covering the subject of printed circuits from the design's idea to final acceptance, this enormously well-received work includes double-sided plated boards through printed boards and also the major variations such as multilayer and flexible circuits.
126/089 Pub Pr., $32.50 Club Pr., $24.50

PRINCIPLES OF INTERACTIVE COMPUTER GRAPHICS. By William M. Newman and Robert Sproull. *2nd Ed., 544 pp., illus.* Now in a revised, updated Second Edition, this is a volume that has long been THE standard source of information for designers!
463/387 Pub. Pr., $24.95 Club Pr., $19.95

ELECTRONICS ENGINEERS' HANDBOOK. Editor in Chief, D. G. Fink. *2,104 pp., 2026 illus.* Brings together in one instant-reference volume the essential principles, data, and design information known today on the components, circuits, equipment, and systems of all the various specialties that make up modern electronics.
209/804 Pub. Pr., $57.50 Club Pr., $40.50

THE 8080A BUGBOOK: Microcomputer Interfacing and Programming. By Peter R. Rony, David G. Larsen, and Jonathan A. Titus. *416 pp., with figures, charts, and tables, paperbound.* Gives you the basic concepts of microcomputer interfacing and the associated microcomputer I/O programming to develop your own interfaces. For the 8080 user, this book will be invaluable.
783/845 Pub Pr., $9.95 Club Pr., $8.45

and GET ONE FREE (values up to $60.00)
COMPUTER PROFESSIONALS' BOOK CLUB



COMPUTER DICTIONARY AND HANDBOOK. By Charles and Robert Sippl. *624 pp., illus.* This handy reference/guide defines *and* explains a wide range of computer procedures, products, problems, and applications. Appendixes provide a "state-of-the art" guide to essential computer concepts.
582079-X Pub. Pr., $29.95 Club Pr., $24.95

ELECTRONIC GAMES, Design, Programming and Troubleshooting. By W. H. Buchsbaum and R. Mauro. *335 pp., 338 illus.* Information you need to design, program, and troubleshoot electronic games is right here in this widely popular hands-on guide.
087/210 Pub. Pr., $21.50 Club Pr., $16.50

MEMORY DESIGN: Microcomputers to Mainframes *Edited by* LAURENCE ALTMAN. *192 pp., illus., 8½ x 11 format* Keep "up" with memory chips through this collection of key articles from *Electronics* magazine. Data, diagrams, and discussions put all the technology to work for you in one authoritative book—a volume so up to date it's a pleasure to use.
191/549 Pub. Pr., $22.50 Club Pr., $17.95

PROGRAMMING LANGUAGES. By Allen B. Tucker, Jr. *439 pp., illus.* Gives you not only the *principles* of design but the *applications* of six major programming languages. Shows you their strengths and weaknesses in solving various representative "benchmark" problems.
654/158 Pub. Pr., $23.95 Club Pr., $16.95

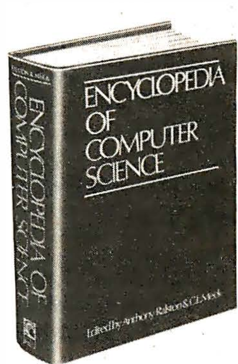
MICROCOMPUTERS/ MICROPROCESSORS Hardware, Software, and Applications. By John L. Hilburn and Paul N. Julich. *372 pp., illus.* Expressly created for people involved in the design, use, or maintenance of digital systems using microcomputers. The authors describe the theory and workings behind microprocessor architecture, read-only memory (ROM), random-access memory (RAM), and input/output interfacing methods.
771/449 Pub Pr., $22.50 Club Pr., $16.50

LOGIC DESIGNER'S MANUAL. By John D. Lenk. *504 pp., illus.* Written for logic IC users rather than for designers of logic ICs, this book uses time-tested existing commercial logic ICs to solve all design and application problems.
784/671 Pub Pr., $18.95 Club Pr., $15.75

HOW TO DESIGN AND BUILD YOUR OWN CUSTOM TV GAMES. By David L. Heiserman. *544 pp., illus.* Shows you how to create and build TV games from scratch *and modify the ones you already have*.
786/585 Pub Pr., $14.95 Club Pr., $11.95

MICROPROCESSOR APPLICATIONS MANUAL. By Motorola Semiconductor Products, Inc. *720 pp., illus., 8½ x 11 format.* With nuts-and-bolts practicality, this manual by the Motorola people (who should know) gives you detailed applications information on microprocessors and assumes no prior knowledge on your part about MPUs.
435/278 Pub Pr., $38.00 Club Pr., $26.50

PERSONAL COMPUTING: Hardware and Software Basics ELECTRONIC BOOK SERIES. *224 pp., 175 illus., outsized 8½ x 11 format* Gives you comprehensive guidance to the present state of the art in personal computers—an overall survey of the technology, and methods available to perform various tasks, facts about the work others are doing—and just how they are doing it.
191/514 Pub. Pr., $19.50 Club Pr., $15.50



ENCYCLOPEDIA OF COMPUTER SCIENCE. Edited by Anthony Ralston and C. L. Meek. *1,500 pp., 60 illus., 100 charts, 7 x 10 format.* This first and only in-depth coverage of the entire field of computer science in a single volume is comprehensive and completely up to date.
769/01X Pub Pr., $60.00 Club Pr., $39.95

ANALOG SYSTEMS FOR MICROPROCESSORS AND MINICOMPUTERS. By Patrick H. Garrett. *248 pp., illus.* Explores all possibilities for analog systems in one applications oriented volume—with many specific examples.
786/496 Pub Pr., $18.95 Club Pr., $14.95

Choose any one of these books at the special club discount, and select any other as your gift Free of Charge when you enroll

Why YOU should join now!

- BEST BOOKS IN YOUR FIELD—Books are selected from a wide range of publishers by expert editors and consultants to give you continuing access to the latest books in your field.
- BIG SAVINGS—Build your library and save money too! We guarantee savings of at least 15% off publishers' list prices on every book. Usually 20%, 25% or even higher!
- BONUS BOOKS—You will *immediately begin to participate in our Bonus Book Plan that allows you savings between 70-80%* off the publisher's price of many books.
- CONVENIENCE—14 times a year you receive the Club Bulletin FREE, fully describing the Main Selection and alternate selections, together with a dated reply card. If you want the Main Selection, you simply do nothing—it will be shipped automatically. If you want an alternate selection—or no book at all—you simply indicate it on the regular reply card and return it by the date specified. You will have at least 10 days to decide. If, because of late mail delivery of the Bulletin you should receive a book you do not want, just return it at the Club's expense.

As a Club member, you agree only to the purchase of four books (including your first selection) over a two-year period.

Computer Professionals' Book Club
P.O. Box 582, Hightstown, New Jersey 08520

Please enroll me as a member and send me the two books indicated, billing me for my first selection only at the discounted member's price, plus local tax, postage and handling. If not satisfied, I may return the books within 10 days and my membership will be canceled. I agree to purchase a minimum of 3 additional books during the next 2 years as outlined under the club plan described in this ad. Membership in the club is continuous but cancellable by me any time after the four book purchase requirement has been fulfilled.

Write Code # of FREE selection here ______ Write Code # of FIRST selection here ______

Orders from outside the U.S. must be prepaid with international money orders in U.S. dollars.

Charge my [ ] VISA [ ] MASTER CHARGE* Exp. Date ______

Credit Card # ______ *MC Bank # ______

Signature ______

Name ______

Address ______

City, State, Zip ______

Corporate Affiliation ______

This order subject to acceptance by McGraw-Hill. All prices subject to change without notice. O er good only to new members. A postage and handling charge is added to all shipments.

P39475

Relocating Assemblers and Linking Loaders

Ottmar E Bochardt, 4560 Decarie #301, Montreal PQ H3X 2H6, Canada

Relocating assemblers and linking loaders are two pieces of assembly-language-oriented software that are probably unfamiliar to the average computer enthusiast. As a matter of fact, the very words *relocating* and *linking* (especially the latter) sometimes conjure up ideas of some vague, unspecified process. In reality, though, relocating assemblers and linking loaders are companion pieces of software that are easy to understand. The purposes of this Technical Forum are to:

- explain the relocating and linking processes;
- compare the two major linking methods;
- demonstrate how the assembly process is made slightly more complicated by relocating and linking;
- comment on the microprocessor-software standard proposed by Formaniak and Leitch.

My machine-language examples are all based on the MOS Technology 6502 processor. The Technical Forum "A Proposed Microprocessor Software Standard" by Peter Formaniak and David Leitch appeared on page 34 of the July 1977 BYTE.

Relocating and Linking Process

A *relocating* assembler is one which assumes that your program will be stored beginning at location zero in memory. In addition to object-module records that give the assembled machine-language code, the relocating assembler also generates extra information in *relocation records* to indicate which parts of the object module must be changed if the code is loaded beginning at some location other than zero.

A relocating loader, then, need only be slightly more intelligent than an ordinary (or absolute) loader. It must be able to:

- separate the input stream into individual object modules;
- assign a relocation address to each module;

Listing 1: *Example output from a relocating assembler. The code followed by the symbol R indicates a relative address, one that will be changed if this code is relocated to any starting location other than hexadecimal 0000. The code followed by the symbol G or G' indicates an external address, one that will have a known value only when this module is linked with other modules of code.*

Hexadecimal Address	Hexadecimal Code	Label	Instruction Mnemonic	Operand	Commentary
0000R			.ENTRY	SUB1	declare SUB1 to be an internal symbol
0000R			.EXTRN	SUB2	
0000R			.EXTRN	COMMON1	
0000R			.EXTRN	VAL001	
0000R	C3 70 00R	SUB1	LDA	COUNT	
0000R	A2 00		LDX	#0	
.					
.					
0040R	CA	LOOP	DEX		
0041R	D4 00 01		STA	DATA	
.					
.					
004DR	A0 00G'		LDY	#VAL001	
004FR	BD 0C 00G		LDA	COMMON1 + 12,X	
0052R	20 00 00G		JSR	SUB2	
0055R	4C 40 00R		JMP	LOOP	
.					
.					
0070R	1E	COUNT	.BYTE	$1E	
.					
.					
009CR	60		RTS		
0000			.ASECT		deposit some absolute code
0100			* = $100		
0100	00 03 07	DATA	.BYTE	0,3,7	
0000R			.END	SUB1	

- load each object module in correct relation to the new beginning address;
- read the relocation records to determine which memory locations must be changed to point to correct locations within the relocated code.

The example given in listing 1, which is source code to be processed by a hypothetical relocating assembler, will help illustrate these functions.

Suppose that the object module is to be loaded at hexadecimal location 0500. The effect of changing the load point of each object module by adding the relocation address shows that all relative addresses (those marked by an R in column 5 of the address) are offset by the amount hexadecimal 500; ie: hexadecimal 500 is added to each of these addresses.

Certain addresses within a portion of code are referred to in the code itself. If the code is moved (or *relocated*) to a different location, all references to these addresses (which are called *relative addresses*) must be changed so as to point to the correct location within the newly relocated code. Specifically, if the relocatable machine code is written to begin at memory location 0000, all references to a relative address must be replaced by the sum of the original address plus the relocation offset (which is equal to the beginning address of the code in its new location).

An example of this is the JMP LOOP instruction at hexadecimal location 0055 in listing 1. When the code is written to begin at hexadecimal location 0000, the label LOOP refers to memory location 0040. However, when this code is relocated to location 0500, LOOP becomes location 0540, and the JMP LOOP instruction now at 0555 is 4C 40 05 (4C is the JMP op code, and 40 05 is the address 0540, as stored in the computer, low byte first). In the example of listing 1, all data flagged with an R will be incremented by 0500.

(Note, however, that a relative address is not to be confused with assembly-language relative addressing. The latter refers to a mode of addressing available in the instruction sets of most microprocessors, where the byte being addressed is specified by how far away that byte is from the beginning of the next instruction. A relative addressing displacement byte is usually limited to a signed, one-byte quantity. A relative address, as part of a relocatable object module, is a two-byte address (for all 8-bit microcomputers) that must be changed when the module is relocated to another beginning address.)

An *absolute address* is an address that is not modified during the relocation process because it refers to a portion of memory outside the area being relocated. In our example of listing 1, the three bytes at 0100 are designated as being absolute (because they follow the .ASECT or *absolute* section pseudo-operation). When this section of code is relocated to hexadecimal 0500, the data bytes will still be at 0100. Thus, the reference to DATA (in the STA DATA line) still points to location 0100. This is because the data at 0100 has not been relocated.

Often assembly-language modules are written separately and are meant to be combined at a later time. In many cases, these modules reference each other. A label used in one program but defined in another is called

ΩMEGA SALES CO.

"WHOLESALE COMPUTER PRICES" DIRECT TO THE PUBLIC

12 Meeting St., Cumberland, R.I. 02864


TRS•80
Model II - $3,500

PRODUCT SPECIAL
OF THE MONTH!!



Atari 800
$749.00

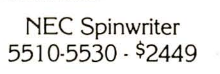
Products are NOW IN STOCK AT ΩMEGA Sales Co.


Apple II
16K - $1049


INTERTEC SUPERBRAIN
32K RAM - $2449.00
64K RAM - $2649.00

For: TRS•80, Apple, CBM.
(Interface Included)


Epson TX-80 - $745



NEC Spinwriter
5510-5530 - $2449


Soroc 120 - $699

CALL TOLL FREE FOR ΩMEGA'S PRICE!

ΩMEGA OFFERS THE BEST DELIVERY AND PRICE ON:
APPLE • ATARI • TRS•80 MODEL II • INTERTEC •
T.I. 810 • HEWLETT-PACKARD-85 • SOROC •
COMMODORE • NEC • QUME • CENTRONICS

ΩMEGA sells only factory fresh, top quality merchandise to our customers.
ΩMEGA will try to match any current advertised price with similar purchase conditions.
Before you buy anywhere else - be sure to call ΩMEGA Sales Co.
1-401-722-1027 or

ΩMEGA TOLL FREE **1-800-556-7587**

ΩMEGA ships via UPS, truck, or air. COD's, VISA, Mastercharge accepted.





Circle 118 on inquiry card.

an *external symbol*. When the modules are combined into one program, not only must they be relocated to separate memory areas, but they must also be *linked*; ie: the relocated values of each of the external symbols must be known by all of the modules. This means that the external symbols must be declared as such within the assembly-language source file.

In the sample program of listing 1, the purpose of the .ENTRY pseudo-operation is to declare that the value of the label SUB1 (ie: the address of the routine's entry point) is to be made available to other assembly modules. The character string "SUB1" and its value will be included in the object module, as part of an *internal symbol* record.

The next three statements indicate that the symbols SUB2, COMMON1, and VAL001 are referenced but not defined by this module (they will be defined later, when the modules are linked). These external symbols must be defined as internal symbols by exactly one of the assembly modules present at linking time. All listing lines flagged with a G or G' have an associated entry in an *external symbol record*, which includes the label name and a pointer to the label's use within the module. For example, the load module used with the module in listing 1 will have an external symbol record that associates the symbol "SUB2" with the address 0053R.

Implementing the Link Process

As an example, let us look at the format of *object modules* (ie: the machine-language module created by assembling a source module) resulting from the Mostek SDB-80 assembler. (A description of this standard is given by Formaniak and Leitch. See references.)

For each external symbol found, only one object record is produced. All references to a given symbol are linked together with the external-symbol record containing the address of the head of the list and the last entry in the list containing the hexadecimal value FFFF. (See figure 1.) In other words, when the SDB-80 assembler encounters an external reference, it uses that two-byte memory location to indicate to the loader where to find the *previous* reference to that symbol.

In terms of object-file size, this is probably the most efficient way to store linkage information, because it guarantees that only one external-symbol record per symbol will be used, regardless of how many times the symbol is referenced. It follows that, since the number of records being processed is smaller because of the link process, the time taken to link a series of object files will be minimized.

In the case of assembler source code (especially when written for a 6502 or similar processor), this linkage technique has several drawbacks. First of all, there is no provision for handling single-byte values, because two bytes of memory are required within the object code for the pointers. This is a serious deficiency for machines like the MOS Technology 6502 and the Motorola 6800, because these processors allow heavy use of page-zero addressing; in this manner the user can specify an address with one byte. Also, it is convenient to define small-valued parameters externally (such as VAL001 in listing 1) for use in two-byte instructions; the Mostek and other assemblers do not allow this.

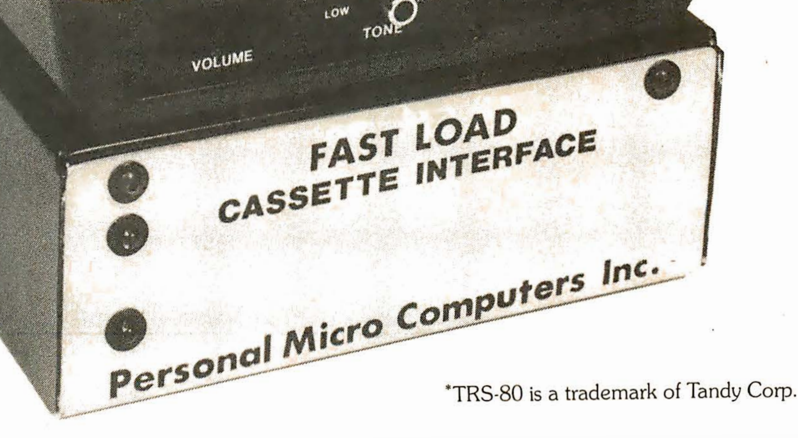
Another point: it is impossible to specify an external symbol as having an absolute address. This is due to the fact that the *internal symbols* (symbols that have an address equated with them, such as SUB1 and LOOP in listing 1) do not contain a flag to indicate whether the

Hexadecimal Address	Hexadecimal Code	Instruction Mnemonic	Operand	Commentary
*		*	*	
0000R		.ENTRY	SUB2	
0000R		.EXTRN	XTR1	this is external symbol
.		.		
.		.		
.		.		
0021R	20 FFFF	JSR	XTR1	first reference (end of chain)
.	↑	.		
.		.		
003AR	20 00 22	JSR	XTR1	backwards pointer to 0022
.	↑	.		
.		.		
004ER	20 00 3B	JSR	XTR1	backwards pointer to 003B
.		.		
.		.		
006FR		.END	SUB2	

Figure 1: *Keeping track of external symbol use with a linked list. When the source file of an assembly-language module (consisting of the columns marked with an asterisk) is assembled into an object module of machine-language bytes, an* external symbol record *is created which points to the last place that the symbol is used (ie: the last memory location that must be filled with the address of the symbol, once that address is known—after linking). Within the* data records *that contain the object code for the routine, each reference of the external symbol points to the address of the previous reference, with a value of hexadecimal FFFF terminating the chain; this is shown by the arrows in the second column.*

Fastload

FOR TRS-80* MODEL I USERS ONLY





*TRS-80 is a trademark of Tandy Corp.

- High speed load TRS-80* Level II cassettes
- Input 15K byte Level II program in 15 seconds
- Search BASIC or SYSTEM programs by name

Unlike other high speed tape input devices, FASTLOAD uses standard format cassettes. Therefore, there is no need to re-record on other media. At 8000 baud, FASTLOAD is faster than disk for short programs. FASTLOAD reads tapes at the fast-forward speed of the CTR-41 cassette recorder. The recorder can also be used for CSAVE at the normal speed.

FASTLOAD connects to the 40 pin I/O or to the Expansion box. The control program does not use computer memory because it is in a built-in PROM. Other valuable features are keyboard debounce program, automatic key repeat routine and key-beep via cassette speaker. Price is $188.00 for FASTLOAD and $95.00 for the modified CTR-41 recorder.

Personal Micro Computers Inc.

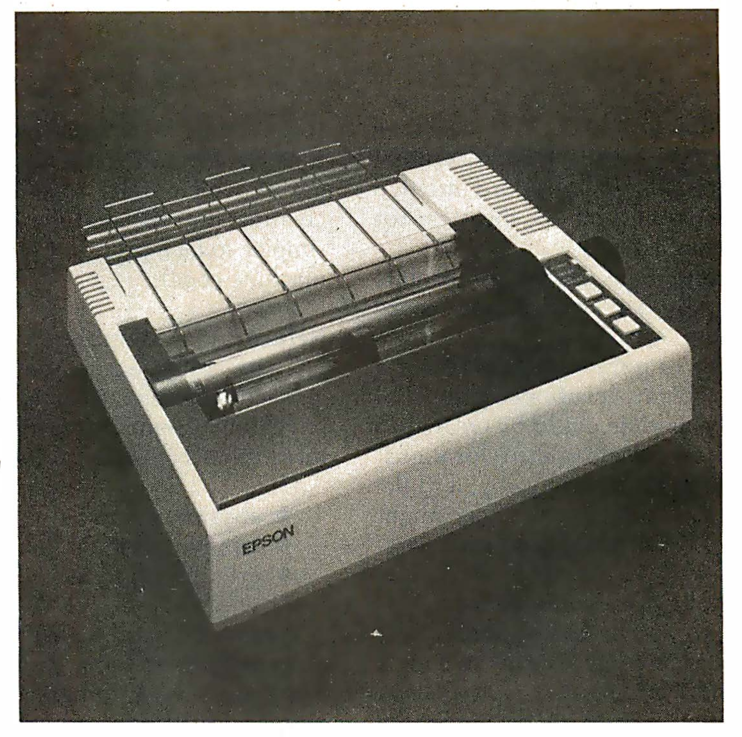
475 Ellis Street, Mountain View, CA 94043 (415) 968-1604

Circle 119 on inquiry card.

Listing 2: *Use of a separate page-zero assembly module. Use of a module like this on computers that have a set of special page-zero addresses allows page-zero addresses (such as XNOW) and system parameters (such as XMAX) to be defined in a central location.*

Hexadecimal Address	Hexadecimal Code	Label	Instruction Mnemonic	Operand	Commentary
0000R			.NLIST		turn off the listing
0000			.ASECT		enter absolute mode
000F			* = 15		
		;			
		;	common variables		
		;			
0010		XNOW	* = *+1		current horizontal position
0011		YNOW	* = *+1		current vertical position
0012		XVEL	* = *+1		horizontal velocity
.					
.					
		;			
		;	simulator parameters		
		;			
	00 A0	XMAX	EQU	160	maximum horizontal location
	00 0C	XVMAX	EQU	12	maximum horizontal velocity
.					
.					
0000R			.CSECT		re-enter relative mode
0000R			.LIST		turn the listing back on

If you just bought another printer, boy are you gonna be sorry.



Epson.

The Epson MX-80. It's not just another worked-over rehash of last year's model. It's our top-of-the-line 80-column printer. It's new. From the ground up. And it's the most revolutionary printer to hit the market since Epson invented small printers for the 1964 Olympics in Tokyo. Don't take our word for it, though. Compare. There simply isn't a better value in an 80-column printer. Period.

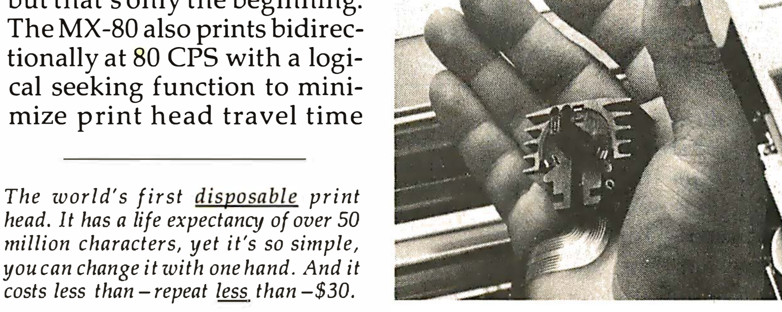
But here's the fact that's going to stand the printer world on its ear. The MX-80 sports the world's first *disposable* print head. After it's printed about 50 million characters, you can throw it away. Because a new one costs less than $30, and the only tool you need to change it is attached to the end of your arm.

Now that's revolutionary, but that's only the beginning. The MX-80 also prints bidirectionally at 80 CPS with a logical seeking function to minimize print head travel time and maximize throughput. It prints 96 ASCII, 64 graphic and eight international characters in a tack-sharp 9x9 matrix. And it provides a user-defined choice of 40, 80, 66 or 132 columns and multiple type fonts.

We spent three long years developing the MX-80 as the first of a revolutionary series of Epson MX Printers. We employed the most advanced automatic assembly and machining techniques in existence to produce a printer that is incredibly versatile, remarkably reliable and extraordinarily inexpensive. It's a printer that could only come from the world's largest manufacturer of print mechanisms: Epson.

If it sounds like we're proud of the MX-80, we are. Not only does it do things some of the world's most expensive printers can't do, it'll do them for you for less than $650. That's right. Under $650.

And if that isn't revolutionary, we don't know what is.



The world's first disposable print head. It has a life expectancy of over 50 million characters, yet it's so simple, you can change it with one hand. And it costs less than – repeat less than – $30.



EPSON AMERICA, INC.

23844 Hawthorne Boulevard, Torrance, California 90505, Telephone (213) 378-2220

Circle 121 on inquiry card.

defined symbol is relative or absolute. This could be changed by adding a flag byte to the internal-symbol record or by splitting the external-symbol record into two types: one for relocatable external symbols, the other for absolute-valued external symbols.

Also notice that code cannot be placed in absolute locations, because there is only one kind of data record and it is subject to relocation.

In all fairness, I would like to point out that there is a way around most of the problems mentioned above. A separate page-zero assembly module could be created to define both the addresses of all page-zero locations, which would probably have to be done anyway, and the values of all parameters that the system designer might want to change. This idea is demonstrated by the example given in listing 2.

Any good assembler should have some sort of copy command that instructs it to accept in-line source text from a separate file; this could be used to easily include a zero-page module like listing 2 wherever it is needed. A less convenient alternative would be to always prefix the page-zero module to the assembler input stream. This method of information binding (ie: giving a symbol its final value; see references, Elson) has the advantage of forcing the designer to define all assembly variables centrally, rather than having them scattered throughout the source code. Unfortunately, a major redefinition of the page-zero module would require reassembly of all associated programs. Also, the additional I/O (input/output) for the page-zero module could prove to be time- and resource-consuming on limited systems.

I have one more criticism about the proposed standard: it does not allow external variables to be referenced in an operand-arithmetic expression. This can be a strong drawback when referring to many fixed-data structures. Consider the following external declaration, written in FORTRAN:

```
COMMON / STATUS / XNOW, YNOW, XVEL ... /
```

An external declaration in any compiled language will take this form. Quite obviously, it should be possible to directly address any one of the variables in the common block. However, only the value of STATUS (the beginning address of the common block) is available using the proposed Mostek standard; the instruction would be .EXTRN STATUS. This means that a reference to XVEL, for example, could be done only through an address computation (ie: its address is equal to that of STATUS plus a certain number of bytes). Needless to say, the result is a waste of machine time, memory, and perhaps microprocessor facilities (eg: an index register). This problem directly affects the assembler programmer, since his coding style is interfered with.

The most practical alternative would be to allow offsets in external references. The offset could then be stored in the target location, to be adjusted at link time (the method shown in the program of listing 2). This will necessitate one entry in an external symbol record for each reference to that symbol in a source program. The result is, of course, increased object-module size and increased time taken to link or load a given set of modules. It is possible to decrease both program size and execution time by separating the linking loader into a *linker* program (which links together a set of object modules, creating one file of fully defined machine code) and a simpler *loader* program (which loads the already linked machine code).

Relocating Assemblers

To an absolute assembler, all variable names are alike; ie: each represents a known value. On the other hand, a relocating assembler must be able to distinguish between three types of entries in its symbol table:

- absolute symbols
- relative symbols
- external symbols

When a relocating assembler encounters an arithmetic expression containing more than one symbol, it must determine several things: whether the expression is valid or not; and if it is valid, what its value is and whether an external or a relocation record (if any) need be written. Also, the use of arithmetic operators is limited by the combination of symbols being worked upon. For example, REL + EXT is valid if an external record is generated for the resulting sum; REL - REL is always valid; but REL - EXT is always invalid. (REL and EXT refer to a relative and an external symbol, respectively.) The actual rules for combination of symbols are more complicated and must be taken into account when designing a linking assembler.

An additional difference is that a relocating assembler must be able to recognize specialized directives. The ones that I have used in this article are:

.ASECT	enter absolute mode
.CSECT	enter relative mode
.ENTRY	define a list of internal symbols
.EXTRN	define a list of external symbols

In addition to these, there should be a directive to explicitly declare a one-byte external symbol, so that the assembler will know whether or not to generate a short (page-zero) form of an ambiguous instruction. As previously noted, this is most relevant to 6502- and 6800-type processors.

As shown in the previous section, a relocating assembler need be only slightly more complex than an absolute assembler, and allows the use of modular software-generation techniques. Unless the system being developed is extremely small (eg: 512 bytes or less), its advantages easily outweigh its drawbacks. ■

References

Elson, M, *Concepts of Programming Languages*, Science Research Associates, Chicago IL, 1973.

Formaniak, P G, and Leitch, D, "A Proposed Microprocessor Software Standard," July 1977 BYTE, page 34.

The COMPUTER FACTORY

TO ORDER CALL (212) 687-5000

SUPERBRAIN™



INTERTEC DATA SYSTEMS

64K ONLY $2995

32K $2795

More than an intelligent terminal, the SuperBrain outperforms many other systems costing three to five times as much. Endowed with a hefty amount of available software (BASIC, FORTRAN, COBOL), the SuperBrain is ready to take on your toughest assignment. You name it! General Ledger, Accounts Receivable, Payroll, Inventory or Word Processing. . .the SuperBrain handles all of them with ease

FEATURES INCLUDE:

- 2 dual-density minifloppies with 360K bytes of disk storage • A CP/M Disk Operating System with a high-powered text editor, assembler and debugger.

Model QD
720K Bytes disk storage and 64K RAM
$3895

SUPER BRAIN HARD DISKS

10 Megabyte	16 Fixed-16 Removable
$3995	**$5995**





NEW AMPEX HARD DISK
5 Fixed
5 Removable
Only $5995

APPLE II PLUS $1195

A complete self-contained computer system with APPLESOFT floating point BASIC in ROM, full ASC I I keyboard in a light weight molded carrying case.

Features Include:

- auto-start ROM • Hi-Res graphics and 15 color video output.
- Expandable to 48K.

Supertalker	$279	Micromodem	$379
Disk	595	Superterm (24 x 80)	395
Add-on Disk	495	Speechlab	229
Pascal Card	495	Communication Card	225
Business Software	625	Modem	200
Monitor	159	Graphics Printer	595
Printer Card	180	Graphics Tablet	795



IS FINALLY HERE 128K RAM!!



FOR BEST DELIVERY AND SUPPORT SEE IT AT THE COMPUTER FACTORY



NEW 80 COLUMN

CBM
Basic 4.0 Operating System

- 80 column by 25 line display
- 12" CRT
- New screen editor
- Split screen processing
- Super fast string handling
- 15 additional basic commands
- Supports relative record processing

Model 8016	Model 8032
16K memory	32K memory
$1495	**$1795**

AND

NEW 8050 DUAL DISK
1 million bytes on-line storage
and DOS 2.0 operating system

- Supports relative record (Random Access)
- Faster more reliable

only **$1695**

CENTRONICS 704



- 180 cps Bi-Directional • Up to 15" Paper Width • 9 x 9 Matrix
- Upper/Lower Case
- Tractor Feed
- RS-232 Serial Interface

$1895
List $2500

CENTRONICS 700-9
$1295 List $1895
• 60 cps • Up to 15" paper width • Tractor Feed • Parallel Interface for Apple & TRS-80 • 2 channel vertical forms! • Top of Form!

CENTRONICS(Letter quality)
737 Serial $995
737 Parallel $965

CENTRONICS
730 Serial $775
730 Parallel $745

Commodore Computer

These low cost Commodore PET **Business Computers** have virtually unlimited business capabilities. Accounts Receivable, Inventory Records, Payroll, and other accounting functions.



PET 16N & 32N COMPUTERS
- Full size keyboard
- 16 or 32,000 Bytes Memory
- Level III Operating System
- Full Screen Editor
- Upper lower case & 64 graphic characters

PET DUAL FLOPPY DISK
- Stores 360,000 Bytes on-line
- Microprocessor controlled
- Uses single or dual sided floppies

$1295

HI-SPEED PRINTER
- 150 characters per second • Up to 4 copies 8" wide
- Microprocessor Controlled • Prints All Graphics • Full Formatting Capability

$695

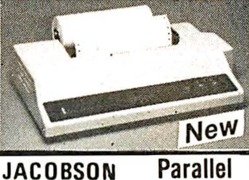
PERIPHERALS

24K Memory Expansion	$499
16K Memory Expansion	399
PET to RS232 Serial	179
2 Way Serial/Communication	229
Modem Board for PET	375
Analog to Digital Board for 16 Devices	275
Second Cassette Drive	95

DIP – 81 BIDIRECTIONAL 100 CPS
MATRIX PRINTER

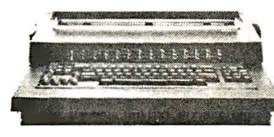
- Centronics interface
- Serial add $50
- Ribbon cartridge
- American made
- 80 column

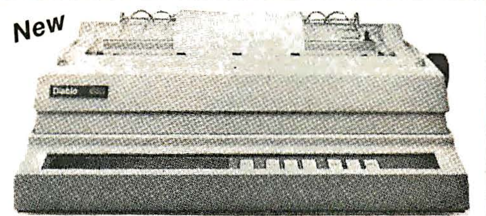
$495



ANDERSON JACOBSON
841 I/O Terminal Ideal for word processing and small businesses.
- ASCII Code
- 15 CPS Printout
- High Quality Selectric Printing
- Reliable heavy duty mechanism
- Completely Refurbished by A.J.
- Delivered FREE to nearest service center

Parallel $1130
Serial $1230





XEROX 1730
Letter Quality Printer

List $2755 **Special $2495**

90 Day On Site Warranty
- 40 Cps
- Uses all 100 metal & plastic daisy wheels
- Automatic bidirectional printing
- Fewer moving parts

XYMEC HQ 1000
with 10, 12, 15 Pitch & Proportional Spacing
- Z-80 controlled
- Up to 198 columns

$2495

VISA



Min.Credit Card Order $75

N Y residents add 8% sales tax
• Same day shipment on prepaid and credit card orders

TO ORDER CALL (212) 687-5000 Open Mon-Fri.10-6 Sat. 11-5

The COMPUTER FACTORY 485 Lexington Ave., New York, NY 10017 (46th St. Lobby)
Foreign order desk — Telex 640055

NEECO PROUDLY INTRODUCES

ALTOS COMPUTERS



ALTOS ACS 8000-5

- Dual 8" floppy disks
- Megabyte storage
- 64K RAM
- Totally expandable to Hard Disk (29MB) and Multi-User

ALTOS OFFERS OUR USERS TOTAL SYSTEM CAPABILITIES AND FLEXIBILITY . . .

- Z80 based • CP/M • Multi-User
- Hard Disk • Seven languages
- MP/M • NEECO system support
- Full Word Processing

$5990

"ALTOS Computers offer you System Flexibility and Reliability"

CONTACT NEECO FOR ADDITIONAL INFORMATION ON HOW ALTOS CAN BECOME YOUR COMPUTER SOLUTION.

Altos computers range in price from less than $3000 to over $14,000. Altos Computer Systems' capabilities range from single disk-single user to 29 Megabytes-Multi-User.

ALTOS computers are distributed to Dealers/OEMs in the N.E. Region by MICROAMERICA

SUPERBRAIN SOFTWARE

(Business Packages written in MicrosoftBASIC)

Trial Tested Osborne Business Packages on the Superbrain

- Accounts Receivable $250.00
- General Ledger $250.00
- Accounts Payable $250.00
- Payroll Package $250.00

Complete 4 Module Package $795

MicrosoftBASIC $325

SUPERBRAIN

32K RAM $2795

64K RAM $2995

FORTRAN $ 450

SPECIAL OFFER!
Purchase a 64K Superbrain at $2995 and will include MBASIC5 for only $250! (regularly $350)

SPECIAL OFFER! - Purchase a Centronics 704-9 (RS232, 180 CPS, retail $2380) printer and a 64K Superbrain together for only $4595 - cash price only.

"The Superbrain is ideal for use as an intelligent terminal or stand alone microcomputer system for OEM's, commercial customers, and other sophisticated computer users."

- Two 5.25" Shugart Minifloppies with over 300 K (CP/M Version 2.2 or later) Disk Storage.
- Integrated in a single compact housing.
- CP/M operating System with MBASIC5 and other interpreters/compilers available.
- 32K or 64K RAM models available.
- 2 I/O Ports - one fully enabled RS232 port for communications. Other port for RS232 serial printer output.
- Too many software packages are now available to list them here.

OEM/DEALER INQUIRIES

All pricing and specifications are subject to change.

SUPERBRAIN™
The Honor Graduate

$2995



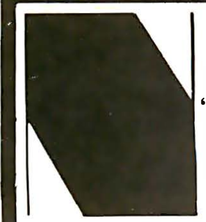
NEECO
679 Highland Ave.
Needham, MA
02194

Mon-Fri 9:30-5:30
MasterCharge &
Visa Accepted
(617) 449-1760
Telex: 951021

MICROAMERICA DISTRIBUTING
"Nationwide distributors of Computer Equipment"
21 Putnam Street
Needham, MA
02194
(617) 449-4310

Circle 122 for NEECO

Circle 123 for Microamerica



NEECO

"Your complete source for all CBM Hardware and Software Products"

PROUDLY ANNOUNCES OUR NEW ONE YEAR WARRANTY ON ALL CBM COMPUTERS!

"All CBM Computers purchased between June 15th and Sept. 15th will automatically carry a full one year NEECO warranty"

The 8032 CBM Computer is now available!

commodore





CBM™ 8000 SERIES BUSINESS COMPUTERS

The new Commodore 8000 series computers offer a wide screen display to show you up to 80-character lines of information. Text editing and report formatting are faster and easier with the new wide-screen display. The 8000 series also provides a resident Operating System with expanded functional capabilities. You can use BASIC on the 8000 computers in both interactive and program modes, with expanded commands and functions for arithmetic, editing, and disk file management. The CBM 8000 series computers are ideally suited for the computing needs of the business marketplace.

CBM™ 8050 DUAL DRIVE FLOPPY DISK

The CBM 8050 Dual Drive Floppy Disk is an enhanced version of the intelligent CBM 2040 Disk Drive. The CBM 8050 has all of the features of the CBM 2040, and provides more powerful software capabilities, as well as nearly one megabyte of online storage capacity. The CBM 8050 supplies relative record files and automatic diskette initialization. It can copy all the files from one diskette to another without copying unused space. The CBM 8050 also offers improved error recovery and the ability to append to sequential files.

HARDWARE SPECIFICATIONS

- Dual Drives
- Two microprocessors
- 974K Bytes storage on two 5.25" diskettes (single sided)
- Tracks 70
- Sectors 17-21
- Soft sector format
- IEEE-488 interface
- Combination power (green) and error (red) indicator lights
- Drive Activity indicator lights
- Disk Operating System Firmware (12K ROM)
- Disk Buffer (4K RAM)

FIRMWARE

- DOS version 2.1
- Sequential file manipulation
- Sequential user files
- Relative record files
- Append to sequential files
- Improved error recovery
- Automatic diskette initialization
- Automatic directory search
- Command parser for syntax validation
- Program load and save

CBM	PRODUCT DESCRIPTION	PRICE	
4008N	8K RAM-Graphics Keyboard-40 col.	$ 795.00	
4016N	16KN RAM-Graphics Keyboard-40 col.	$ 995.00	
4016B	16K RAM-Business Keyboard-40 col.	$ 995.00	
4032N	32K RAM-Graphics Keyboard-40 col.	$1295.00	
4032B	32K RAM-Business Keyboard-40 col.	$1295.00	
8016	16K RAM-80 Col.-4.1 O/S	$1495.00	*
8032	32K RAM-80 Col.-4.1 O/S	$1795.00	
2023	Friction Feed Printer	$ 695.00	
2022	Tractor Feed Printer	$ 795.00	

NOTE: **All current CBM production computers/disks now contain operating system 4.1/DOS 2.1**

CBM	PRODUCT DESCRIPTION	PRICE	
2040	Dual Floppy-343K-DOS 1.0	$1295.00	
4040	Dual Floppy-343K-DOS 2.0	$1295.00	
8050	Dual Floppy-974K-DOS 2.0	$1695.00	*
C2N Cassette	External Cassette Drive	$ 95.00	
CBM to IEEE	CBM to 1st IEEE Peripheral	$ 39.95	
IEEE to IEEE	CBM to 2nd IEEE Peripheral	$ 49.95	
8010	IEEE 300 Baud Modem	$ 395.00	*
2.0 DOS	DOS Upgrade for 2040	$ 50.00	
4.0 O/S	O/S Upgrade for 40 Column	$ 100.00	

*Asterisks indicate fall delivery—all others are immediately available.

SPECIAL OFFER ON CBM COMPATIBLE BUSINESS SOFTWARE!

Purchasing software has always been difficult due to the "you buy it - you own it" attitude of most vendors. We at NEECO, recognize this problem and can now, on all of the Software Packages listed, offer a full 30 day refund policy to NEECO's customers. Now you can purchase with confidence. Buy it - try it; if the program package is not suitable for any reason, send it back to us within 30 days and we will refund the full purchase price—less shipping charges!

SOFTWARE	APPLICATION	REQUIRES	AUTHOR	AVAILABILITY	PRICE
Word Pro I	Word Processing	8K + cassette	Pro Micro	Immediate	$ 29.95
Word Pro II	"	10K + 2040	"	"	99.95
Word Pro III	"	32K + 2040	"	"	199.95
Word Pro IV	"	8032 + 2040/8050	"	"	299.95
BPI Integrated G/L	Business	32K/8032 + 2040	BPI	"	360.00
BPI Inventory	"	"	"	"	T.B.A.
BPI Payroll	"	"	"	"	"
BPI Enhanced A/R	"	"	"	"	"
CMS G/L	"	"	CMS Software	"	295.00
CMS A/R	"	"	"	"	195.00
CMS A/P	"	"	"	"	195.00
CMS Customer Mail List	"	"	"	"	195.00
CMS Payroll	"	"	"	"	350.00
BMB Database	All Business	32K/8032 + 2050/8050	BMB	August/Sept.	295.00

*Wordprocessing Software requires output printer. We recommend the NEC Spinwriter ($2995) for letter quality.

*PET is a registered trademark of Commodore Business Machines. Small Keyboard PETS require a ROM Retrofit Kit.

Multi-Cluster is available in Canada from BMB Compu Science, P.O. BOX 121, Milton, Ontario, L9T2Y3

All prices and specifications are subject to change without notice.



NEECO
679 HIGHLAND AVE.
NEEDHAM, MA 02194

NEW ENGLAND ELECTRONICS CO., INC.
"NEW ENGLAND's Largest Computer Showroom"

(617) 449-1760
MASTERCHARGE OR VISA ACCEPTED
TELEX NUMBER 951021, NEECO
MON-FRI, 9:00-5:30

Circle 124 on inquiry card.

Varieties of Threaded Code for Language Implementation

Terry Ritter
Gregory Walker
Motorola Inc, Mail Drop M2880
3501 Ed Bluestein Blvd
Austin TX 78721

Between a high-level language (HLL) and its underlying machine architecture lurk many language implementation techniques. These include the older techniques of interpretation and compilation, as well as newer ones like intermediate languages and threaded code. In this article, we will present four types of threaded code techniques for implementing intermediate languages. We will examine how these four logically equivalent techniques offer various trade-offs of execution speed, program storage, and use of processor resources.

Implemention of a Language

The implementation of a high-level language on various logical or physical machine architectures involves such characteristic trade-offs as size of the language implementation, size of generated code, and speed of program execution. We will bypass other issues of high-level language use (eg: interaction, debugging, testing, etc) and concentrate on language implementation considerations.

Language implementation techniques can be logically divided into two categories: translation and interpretation.

Translation: Translation techniques replace elements of higher-level syntax with lower-level instructions that perform an equivalent operation. The resulting translation is then executed in order to run the program. A compiler is a computer program that translates high-level language programs into instructions of another language. Traditionally, assemblers and compilers translate their input into machine-level code.

Interpretation: Interpretation techniques directly execute the high-level language program. The interpreter is a program that sees the high-level language source program as a series of operation (op) codes used to guide its execution. The interpretive system appears to the user as a "virtual machine" that has the architecture of the high-level language.

Any form of interpretation offers significant opportunities for implementing debugging tools. Tests performed as each command is interpreted can result in a programmer-controlled display of debugging information. This is the basis for trace or breakpoint facilities that can be included in the interpreter.

Combinations: Combination techniques may translate the sequence of characters representing a high-level-language keyword into a form that is easier to interpret. Most BASIC interpreters translate the BASIC keywords into one-byte tokens that are easier to identify. This technique avoids the continual string searches of a traditional interpreter, but executes a language that is syntactically unchanged from the high-level-language source program. (For our purposes here, the term *syntax* will specifically refer to the structural relationship between language elements.)

Intermediate language: Intermediate-language (IL) techniques translate the high-level-language programs into a language that is simultaneously easier to deal with and syntactically different from the original. Many compilers translate a high-level-language program into an intermediate language, which is then translated into

About the Authors

Terry Ritter and Gregory Walker are software engineers at the Motorola Microprocessor Design Group, where their exploration into the structure of computer languages led them to examine FORTH and other threaded languages for use as a possible software tool. Terry Ritter is one of the co-architects of the MC6809 microprocessor and has been involved with personal computing since 1974. Gregory Walker is on the IEEE floating-point standards committee and has been involved with microcomputers since 1975.

Intermediate-language techniques offer the advantage of machine independence of the source language.

machine code. When used in this manner, the intermediate language can allow global code-optimization techniques to be more easily applied.

Since the translation into the intermediate language is independent of the target machine, different compilers for the same target machine need only produce the simpler code of the intermediate language. Similarly, different code generators (which translate the intermediate language into machine language) can allow the same compiler to produce code for different computers. Intermediate-language techniques offer the advantage of machine independence of the source language and allow *program portability*, the ability to execute the same source program on widely different computers.

The intermediate-language representation of a program might also be interpreted instead of translated to machine code. To minimize interpretation overhead, we need complex and powerful machine-language routines. But machine independence is best accomplished by having simple, easy-to-write machine-language routines. This same trade-off of machine independence versus execution speed must be made in the design of any intermediate language. An example of this use of intermediate language is the pseudocode (p-code) used to implement most versions of Pascal.

This article is principally concerned with a class of intermediate-language representations particularly suited to interpretation; these are known as *threaded codes*. Naturally, the intermediate-language code will be generated by a compiler or by some other translation program. We will not discuss the translation process, which is a function of the syntax of the high-level language and other programming considerations; rather, we will discuss the resulting intermediate language and its interpreter.

Aspects of Intermediate-Language Architecture

An intermediate language is composed of a set of primitive operations (which, in combination, can express any algorithm) and storage capabilities for both internal and program data. In particular, it must be possible to pass data values between routines that make up the intermediate language. The intermediate-language program can use a fixed number of memory locations to simulate general-purpose registers, but then routines are needed that load (and store) each register from memory, as well as routines that simply move values between registers. If the intermediate language approaches the complexity of the original machine language, its use is of dubious value.

One approach that simplifies an instruction set is a "zero-address" or *stack* architecture. In this architecture, all operations will obtain values by pulling them from the stack and results will be returned by pushing them onto the stack. Only two operations with memory are now required: the "pull (from stack) and store (to memory)" operation and the "load (from memory) and push (on the stack)" operation. By designing a zero-address architec-

The first personal computer for under $200.

The Sinclair ZX80. A complete computer— only $199.95 *plus $5.00 shipping.*

Now, for just $199.95, you can get a complete, powerful, full-function computer, matching or surpassing other personal computers costing several times more.

It's the Sinclair ZX80, the computer that independent tests prove is faster than all previous personal computers. The computer that "Personal Computer World" gave 5 stars for 'excellent value.'

The ZX80 cuts away computer jargon and mystique. It takes you straight into BASIC, the most common, easy-to-use computer language.

You simply take it out of the box, connect it to your TV, and turn it on. And if you want, you can use an ordinary cassette recorder to store programs. With the manual in your hand, you'll be running programs in an hour. Within a week, you'll be writing complex programs with confidence.

All for under $200.

Sophisticated design makes the ZX80 easy to learn, easy to use.

We've packed the conventional computer onto fewer, more powerful LSI chips—including the Z80A microprocessor, the faster version of the famous Z80. This makes the ZX80 the world's first truly portable computer (6½" x 8½" x 1½" and a mere 12 oz.). The ZX80 also features a touch sensitive, wipe-clean keyboard and a 32-character by 24-line display.

Yet, with all this power, the ZX80 is easy to use, even for beginners.



Your course in computing.

The ZX80 comes complete with its own 128-page guide to computing. The manual is perfect for both novice and expert. For every chapter of theory, there's a chapter of practice. So you learn by doing—not just by reading. It makes learning easy, exciting and enjoyable.

The ZX80's advanced design features.

Sinclair's 4K integer BASIC has performance features you'd expect only on much larger and more expensive computers. These include:

- Unique 'one touch' entry. Key words (RUN, PRINT, LIST, etc.) have their own single-key entry and are stored as a single character to reduce typing and save memory space.
- Automatic error detection. A cursor identifies errors immediately to prevent entering programs with faults.
- Powerful text editing facilities.
- Also programmable in machine code.
- Excellent string handling capability—up to 26 string variables of any length.
- Graphics, with 22 standard symbols.
- Built-in random number generator for games and simulations.

Sinclair's BASIC places no arbitrary restrictions on you—with many other flexible features, such as variable names of any length.

And the computer that can do so much for you now will do even more in the future. Options will include expansion of 1K user memory to 16K, a plug-in 8K floating-point BASIC chip, applications software, and other peripherals.

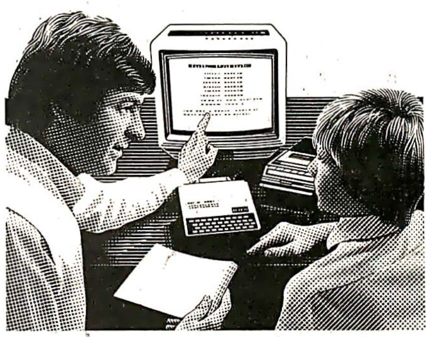
Order your ZX80 now!

The ZX80 is available only by mail from Sinclair, a leading manufacturer of consumer electronics worldwide. We've already sold tens of thousands of units in Europe, so demand will be great.

To order by mail, use the coupon below. But for fastest delivery, order by phone and charge to your Master Charge or VISA. The ZX80 is backed by a 30-day money-back guarantee, a 90-day limited warranty with a national service-by-mail facility, and extended service contracts are available for a minimal charge.

Price includes TV and cassette connectors, AC adaptor, and 128-page manual.

All you need to use your ZX80 is a standard TV (color or black and white). The ZX80 comes complete with connectors that easily hook up to the antenna terminals of your TV. Also included is a connector for a portable cassette recorder, if you choose to store programs. (You use an ordinary blank cassette.)



The ZX80 is a family learning aid. Children 10 and above will quickly understand the principles of computing—and have fun learning.

Phone orders: (203) 265-9171. Mon.-Fri. 8 AM-6 PM EST. We'll deduct the cost of the call from your invoice. (For technical information, call (617) 367-2555, Mon.-Fri. 9 AM-5 PM EST.)

sinclair

Sinclair Research Ltd., 475 Main St., P.O. Box 3027, Wallingford, CT 06492.

To: **Sinclair Research Ltd., 475 Main St., P.O. Box 3027, Wallingford, CT 06492.**
Please send me ________ ZX80 personal computer(s) at $199.95* each (US dollars), plus $5 shipping. (Your ZX80 may be tax deductible.)
I enclose a check/money order payable to Sinclair Research Ltd. for $________.

Name ________

Address ________

City ________ State ________ Zip ________

Occupation: ________ Age: ________

Intended use of ZX80: ________

Have you ever used a computer? ☐ Yes ☐ No.
Do you own another personal computer? ☐ Yes ☐ No. *For Conn. deliveries, add 7% sales tax.

BY-9-0

Circle 128 on inquiry card.

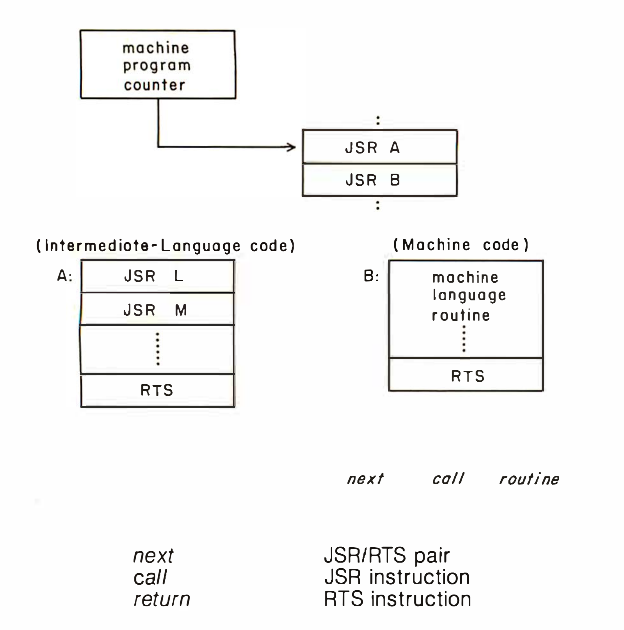


Figure 1: *Diagram of subroutine-threaded code (STC). In this and figures 2 thru 4, the pointer points to the main program being executed. Both A and B are subprograms called by the main program; A is an intermediate-language subprogram of the same type as the main program, and B is an in-line machine-language program that directly executes the machine language of the host computer. The words* next, call, *and* return *refer to operations that must be performed for any threaded-code language. The information to the right of these words tells how each operation is performed in the current type of threaded code.*

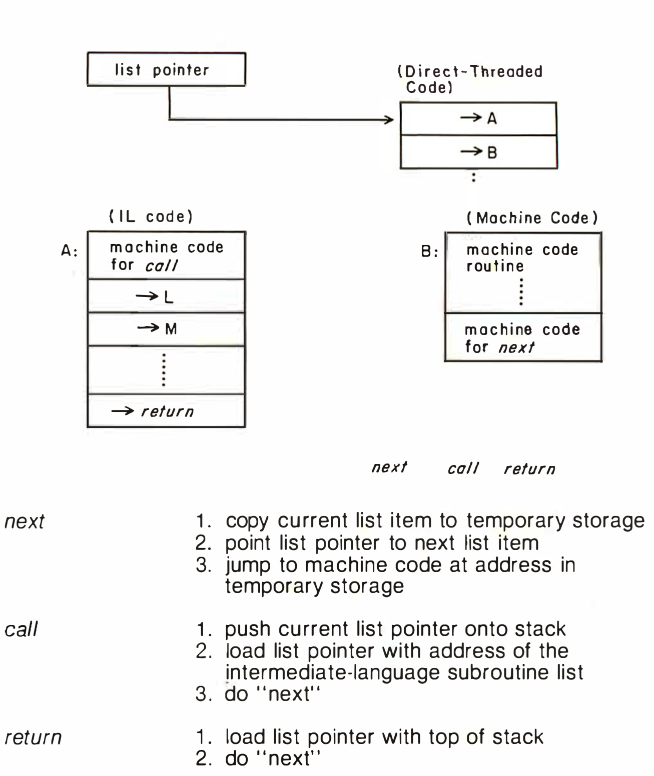


Figure 2: *Diagram of direct-threaded code (DTC). Here, "temporary storage" refers to a memory location that is used to hold the address of the machine-code routine associated with the current unit of code.*

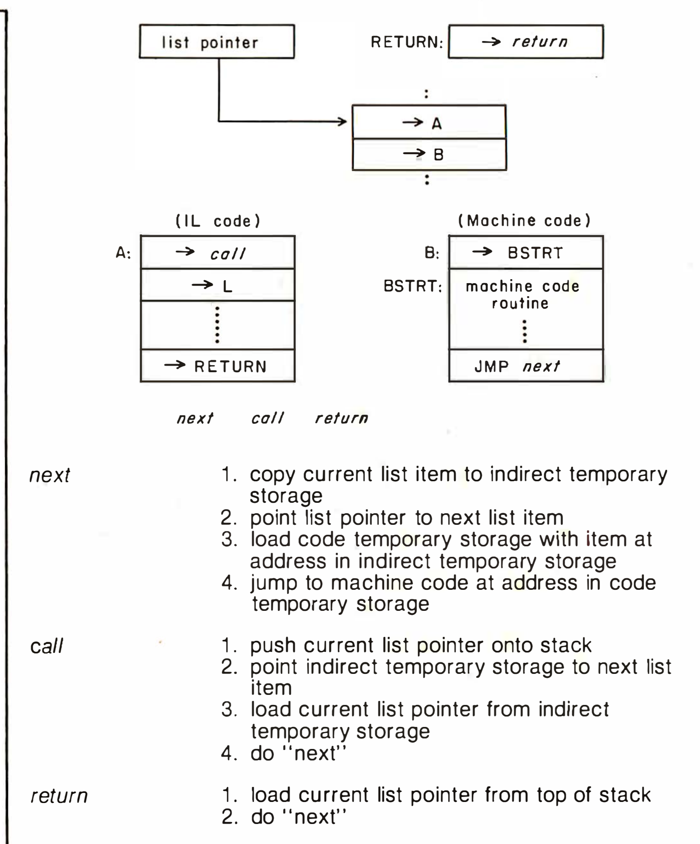


Figure 3: *Diagram of indirect-threaded code (ITC). Here, "indirect temporary storage" and "code temporary storage" store the indirect and direct pointers to the machine code routine associated with the current unit of code.*

ture into the intermediate language, the parameter transfer location is implied and need not be part of the intermediate language representation. (A stack architecture is certainly *simpler* than other architectures, but that does not mean it is *better*; many complex trade-offs that are beyond the scope of this article are involved.)

Threaded Code

Threaded code is an intermediate-language implementation technique that organizes the control of program flow into a sequence of subroutine invocations. *No other aspects of the language are represented in threaded code.* Threaded code is especially applicable to interpretation; the interpretation process consists of transferring control to the routines selected by the threaded-code op codes. The functions available in the intermediate language are provided by the subroutines that are invoked and are not an inherent part of the threaded code itself.

[*The characteristics of the language FORTH are independent of its current implementation via threaded code. FORTH enthusiasts often blur the distinction, attributing the language's speed and compactness to the language instead of to its threaded-code implementation. I think this is an important point to remember when talking about the advantages of FORTH....*GW]

Threaded-code intermediate languages are especially applicable to the implementation of virtual machines embodying zero-address architectures. As such, the technique of using threaded code to implement a language can be applied to, for example, Pascal (using the p-code intermediate language), LISP interpreters, or, of course, FORTH. We classify four varieties of threaded code: subroutine, direct, indirect, and token.

All varieties of threaded code consist of a data structure that is a sequence of unique subroutine identifiers. Traditionally, threaded code has been kept close to the machine level and has included actual pointers to the subroutines (which themselves may be either intermediate language or machine code). Also traditionally, a portion of the processor resources—in particular, processor registers—has been dedicated to the use of the threaded-code interpreter. As we shall see, neither absolute pointers nor register resources need be used to implement threaded code.

Implementing Threaded Structures

We will now describe the structures associated with the various types of threaded code. Figures 1 through 4 present diagrams of subroutine-, direct-, indirect-, and token-threaded code structures, respectively, along with a description of the three operations, *next*, *call*, and *return*, which make up the complete threaded-code interpreter. In the diagrams, the notation "→A" means a pointer to the memory location labeled "A".

Subroutine-threaded code: A sequence of subroutine calls *with no other embedded instructions* implements an intermediate language. Each subroutine call may be considered a single intermediate-language operation, which need not be related to the underlying machine architecture. Subroutine-threaded code (STC) is a control mechanism that is widely supported at the machine-hardware level.

The peculiar program organization consisting only of

subroutine calls is rarely used by programmers (who have no reason to resist obvious opportunities for optimization), but it is sometimes used by compilers. It is the most general intermediate language possible, and it retains the advantages of machine independence by not generating in-line machine language. (The difference in the form of subroutine call and return instructions on various computers is usually trivial.)

Subroutine-threaded code will incur less execution overhead than most intermediate languages because its interpretation is handled by hardware rather than by a sequence of instructions. Furthermore, subroutine-threaded code can be optimized by using in-line machine code for operations where subroutine overhead is excessive, an advantage unobtainable with other types of threaded code. Of course, the resulting optimized code is no longer machine-independent; the additional translation step converts the intermediate language into object code for a particular machine.

Direct-threaded code: Direct-threaded code (DTC) may be considered a sequence of machine-language subroutine calls with the "call" op code removed. This results in a list of addresses, each of which points to a machine-language subroutine. Since the direct-threaded program includes no op codes, a short machine-language program must be written to read the next address in the list and transfer control to that address. Traditional direct-threaded code implementations do not allow the use of true subroutines at the machine level but instead require that each routine terminate by executing the *next* operation.

In order to call direct-threaded routines (see the instructions for "call" in figure 2), machine-language code (executing the instructions for "call") must be included at the beginning of each direct-threaded routine to put the current value of the list pointer on an address stack, load the list-pointer register with the start address of the list of routine addresses for this just-begun, direct-threaded routine, and execute the *next* operation.

The *next* operation (coded here as in-line machine code) causes the computer to execute the routine pointed to by the list pointer, regardless of whether the routine pointed to is another intermediate-language routine or a machine-language routine.

In order to return to a higher level of nesting, the last list item in an intermediate-language routine points to the code for the *return* operation. When executed by the *next* operation, this operation recovers the previous value of the list pointer from the stack, then executes the *next* operation, which in turn executes the first routine past the routine the computer just returned from.

Thus direct-threaded code is implemented in three operations: *next*, *call*, and *return*.

Indirect-threaded code: Indirect-threaded code (ITC) consists of a list of addresses, but each address points to another address which then points to the machine-code routine. (See figure 3.) As compared to direct-threaded code, in indirect-threaded code, the interpreter must go through an extra level of indirection. Indirect-threaded intermediate-language subroutines do not contain machine-language code for the *call* operation, and one advantage of indirect-threaded code is that a compiler using it need only produce pointers. By manipulating only pointers, the compiler generates intermediate-language code that does not include machine-language code itself; thus it is independent of the target machine. However, a disadvantage of indirect-threaded code is that the interpreter has the overhead of an extra level of indirect addressing.

Token-threaded code: The varieties of threaded code previously mentioned contained pointers that were actual addresses of the subroutines in memory. Using memory addresses to select routines wastes storage because the number of subroutines in the system is far smaller than the number of memory locations. A savings in intermediate-language program size can be obtained by using short tokens to identify the subroutines to be invoked. Typically, token-threaded code (TTC) can be implemented by using the current token to index into a table of subroutine addresses. (See figure 4.)

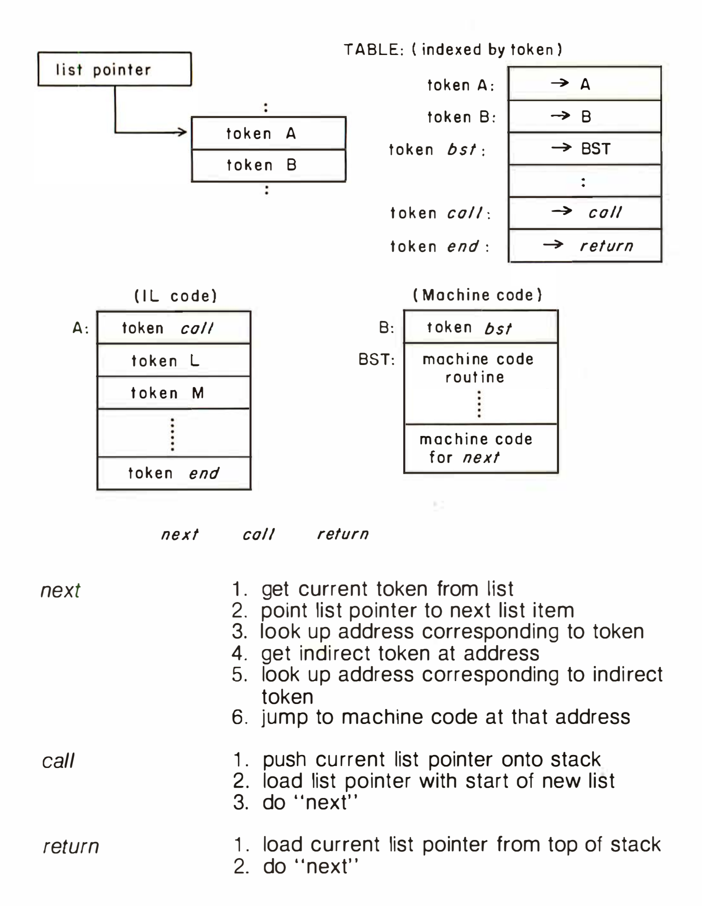


Figure 4: *Diagram of token-threaded code (TTC). Since tokens can be made shorter than addresses, this makes the threaded code more compact, but the table lookup makes the resulting code slower. Here, the "indirect token" is the contents of the table entry that matches the current token of code.*

High-Level Descriptions of Threaded-Code Interpreters

Listings 1 thru 3 illustrate the logical implementation of direct-, indirect-, and token-threaded code, respectively. The program descriptions are written in a high-level language that is similar in appearance to Pascal. It differs from Pascal in that the variables are not declared as standard Pascal data types. Also, the *next*, *call*, and *return* operations are not written as Pascal procedures; this was done to remain faithful to actual implementations where

THE ULTIMATE REFINEMENT.
PL/1 FOR YOUR MICRO.

IBM's told us about PL/1 for years. Now, we're telling them something.

PL/I Subset G. Newly designed expressly for minicomputers by an ANSI committee of PL/I experts. All the best application programming features, refined to match contemporary programming practices.

PL/I-80™ for Microcomputers. Based on Subset G, PL/I-80 runs under our CP/M® and MP/M™ operating systems.

PL/I-80 Means Performance. In an independent benchmark, PL/I-80 was tested against 34 other high-level languages for 8-bit processors, and came out on top. *

PL/1-80 versus the best of several languages:	
PL/I-80	1.00
FORTRAN	1.21
BASIC COMPILER	1.71
PL/M	1.71
PASCAL COMPILER	1.89
PASCAL INTERPRETER	17.07
BASIC INTERPRETER	34.57

*Execution time ratio, Eratosthenes Sieve

Subset G is a brand new language with a new following. DEC®, Data General, and Prime now support it, and the list is growing. There's no better way to protect your software investment.

PL/I-80 from Digital Research. Fast. Economical. Refined. With the programming power of minicomputer PL/I . The package includes compiler, run-time library, linkage editor and relocating macro-assembler, plus three comprehensive manuals. All for only $500.

Interested in Refinement?

Call or write Digital Research. Experts in refinement.

DIGITAL RESEARCH®

P.O. Box 579
801 Lighthouse Avenue
Pacific Grove, CA 93950
408-649-3896
TWX 910 360 5001



Circle 131 on inquiry card.

these three code segments are reached by jump instructions rather than by subroutine calls.

Several other notational conventions used in these listings may also need explanation. The data type *pointer* means an actual machine address. If *ip* is a pointer variable, then → *ip* means the value at the location which is pointed to by the address in variable *ip*. Therefore, the statement

goto → ip;

means jump to a new location using the contents of variable *ip* as the address at which to proceed with execution.

Implementation Concerns

The traditional implementations of threaded-code interpreters have had one or more machine registers dedicated to the exclusive use of the interpreter; implementations on microcomputers have tended to use *all* microprocessor resources. One problem with these implementations is that all machine-language routines (where all real computation is done) must save processor registers before modifying them and must restore them before returning to the interpreter.

Additionally, this use of machine resources, simply for the transfer of control, obstructs the use of standard machine-language subroutines that pass parameters through the registers. In the context of microcomputer

Listing 1: *Description of a direct-threaded code interpreter in a Pascal-like language. See figure 2.*

```
const pointer_length = (length of an address pointer);
      call_code_length = (length of "call" code segment);
var   list_pointer: pointer; { interpreted program counter  }
      list_item:  pointer; {  contains threaded-code item   }
label next,call,return;

next: list_item := ^list_pointer;
      list_pointer := list_pointer + pointer_length;
      goto ^list_item;

call: push_on_stack(list_pointer);
     {  The value of list_item was set by the preceding        }
     {       "next" operation.                                 }
      list_pointer := list_item + call_code_length;
     {  The following code duplicates the "next" operation.    }
      list_item := ^list_pointer;
      list_pointer := list_pointer + pointer_length;
      goto ^list_item;

return:  list_pointer := pop_from_stack();
       {    The following code duplicates the "next" operation. }
         list_item := ^list_pointer;
         list_pointer := list-pointer + pointer_length;
         goto ^list_item;
```

Listing 2: *Description of an indirect-threaded code interpreter in a Pascal-like language. See figure 3.*

```
const pointer_length = (length of an address pointer) ;
var   list_pointer: pointer;  { interpreted program counter  }
      list_item: pointer;     { contains threaded-code item   }
      code_pointer: pointer; { points to actual machine code  }
label next,call,return;

next: list_item := ^list_pointer;
      list_pointer := list_pointer + pointer_length;
      code_pointer := ^list_item;  { here is the extra       }
                                   {  level of indirection  }
      goto ^code_pointer;

call: push_on_stack(list_pointer);
    {  The value of list_item was set by the                  }
    {      preceding "next operation.                         }
      list_pointer := list_item + pointer_length;
    {  The following code duplicates the "next" operation.   }
      list_item := ^list_pointer;
      list_pointer := list_pointer + pointer_length;
      code_pointer := ^list_item;
      goto ^code_pointer;

return:  list_pointer := pop_from_stack();
     {   The following code duplicates the "next" operation.    }
         list_item := ^list_pointer;
         list_pointer := list_pointer + pointer_length;
         code_pointer := ^list_item;
         goto ^code_pointer;
```

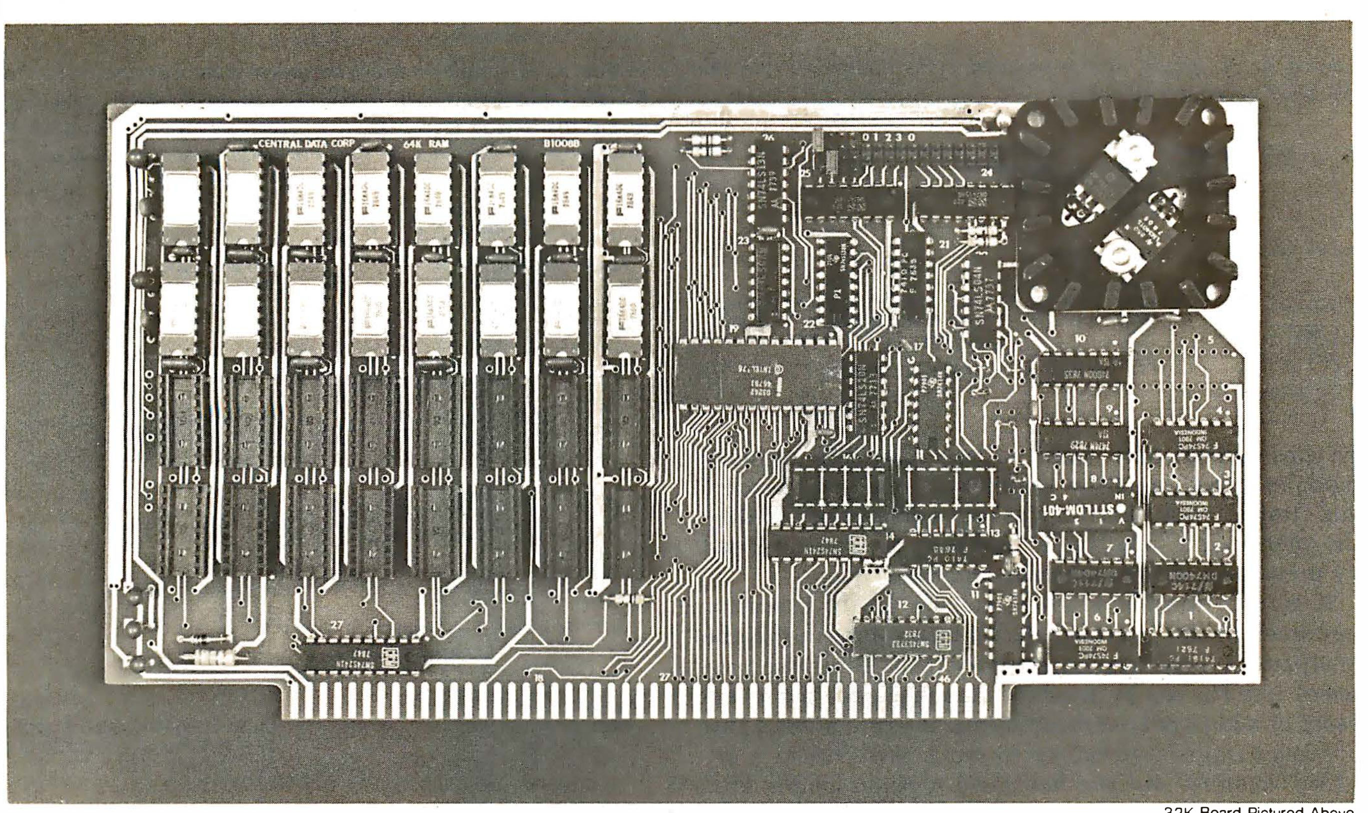
Listing 3: *Description of a token-threaded code interpreter in a Pascal-like language. See figure 4.*

```
const token_length = (length of token) ;
      call_code_length  = (length of "call" code segment);
      toknumber = (number of tokens possible); { is 256 for an }
                                                { 8-bit token   }
var  list_pointer: pointer;  { interpreted program counter  }
     code_pointer: pointer;  { pointer to machine code       }
     table: array[1..toknumber] of pointer; {subroutine table }
     token_item: short token;
label next,call,return;

next: token_item := ^list_pointer;
      list_pointer := list_pointer + token_length;
      code_pointer := table[token_item];
      token_item := ^code_pointer;
      code_pointer := table[token_item];
      goto ^code_pointer;

call: push_on_stack(list_pointer);
    {   The value of the code_pointer was set by the preceding }
    {      "next" operation.                                    }
      list_pointer := code_pointer + call_code_length;
    {   The following code duplicates the "next" operation.    }
      token_item := ^list_pointer;
      list_pointer := list_pointer + token_length;
      code_pointer := table[token_item];
      goto ^code_pointer;

return:  list_pointer := pop_from_stack();
    {   The following code duplicates the "next" operation.     }
        token_item := ^list_pointer;
        list_pointer := list_pointer + token_length;
        code_pointer := table[token_item];
        goto ^code_pointer;
```



32K Board Pictured Above

Why Not the Best?

From <u>The</u> Dynamic RAM Company.

	2MHz	4MHz
16K	$249	$259
32K	$375	$395
48K	$500	$530
64K	$625	$665

We have now been shipping our 2MHz dynamic RAM boards for over two years. Hundreds of 4MHz boards have been going out every month since early 1979. Our reliability is proven in the thousands of systems which contain our board. Many quality-minded systems houses across the country and overseas are using our boards for their equipment.

Our prices still beat all. Despite rising 16K memory chip prices (at least from reputable suppliers), Central Data continues to give you the best buy in memory today. Nobody offers a board with a capacity of 64K, assembled, tested, and guaranteed for a full year at the price we do.

Deselect around PROMs. Our boards have the important deselect feature which lets you overlap any fixed memory in your system with no interference.

Our features make the board easily used and expanded. You address our boards on 16K boundaries with mini-jumps (small shorting plugs that slide over wire-wrap pins) near the top of the board for easy access. If you want to expand your board after you have purchased it, all that you need to do is add memory. We can supply you with expansion packages ($150-2MHz, $160-4MHz) which include eight RAMs that you can depend on as well as two mini-jumps for addressing. And of course, our board **never** generates wait states.

Low power consumption keeps your computer running cool and reliable. The total power consumption of our 16K board is typically less than 4 watts (+8V @ 300ma, +16V @ 150ma and −16V @ 20ma). Boards with additional memory typically increase power consumption only 1 watt per 16K!

Standard S-100 Interface. Our board is designed to interface with any standard S-100 CPU. All of the timing of the board is independent of the processor chip, and the board is set up for different processors by changing two plugs on the board.

Call or write us today. That will guarantee a fast response with more information on the board. Or make an order — you'll probably have the board in two weeks! **If you're interested, also ask for a catalog on our Z8000 16-bit processor board designed for the MULTIBUS.** All of these products are available to your local dealer, also.

Central Data Corporation, 713 Edgebrook Drive, PO Box 2530, Station A, Champaign, IL 61820. (217) 359-8010

Central Data

Circle 133 on inquiry card.

Listing 4: *A simple direct-threaded code interpreter for the MC6809 microprocessor.*

```
        RETURN:  PULS   Y          GET NEW THREAD PTR
                 JMP    [,Y++]     DO "NEXT"


Machl Routine           IL Routine

  _____         CALL:  PSHS   Y
  _____                LEAY   *+7,PCR     STACK OLD THREAD POINTER
  _____                JMP    [,Y++]      ADDR OF FOLLOWING IL CODE
  JMP   [,Y++]         _____
                       _____
                       FDB    RETURN      ADDR OF "RETURN"
```

systems (which may want to use read-only memory modules), this limitation requires that special "header" and "trailer" code be written to move data values used by the intermediate language to and from the registers used by previously written machine-language code.

It is also possible to eliminate the use of processor resources in an intermediate language by storing the interpreter's "registers" in memory; this leaves the processor free for use by machine-language code at the expense of additional overhead during interpretation. [*This overhead consists of having to move these registers between memory and the hardware registers of the host processor when you want to manipulate the contents of the interpreter registers....GW*] The use of absolute locations in memory would itself be a problem, because these locations can then conflict with locations used by other software packages. By saving the intermediate-language registers on the *stack*, the language may be made inde-

Listing 5: *A simple indirect-threaded code interpreter for the MC6809 microprocessor. In this and listings 6 thru 8, each block of information in lowercase is a "stack picture"—ie: a diagram of what is on the stack at that particular place in the code.*

```
          s ->thread ptr 1
              thread ptr 2

  NEXT:   LEAS   -2,S             MAKE SPACE
          PSHS   X                SAVE X

          s ->x
              space
              thread ptr 1
              thread ptr 2

          LDX    [,Y++]           GET ADDRESS OF ROUTINE
          STX    2,S              SAVE AS UPCOMING PC

          s ->x
              routine addr
              thread ptr 1
              thread ptr 2

          PULS   X,PC             RECOVER X AND GO!

          s ->thread ptr 1
              thread ptr 2

  CALL:   PSHS   Y                SAVE CURRENT THREAD PTR
          LDY    ,--Y             GET PREVIOUS INDIRECT PTR
          LEAY   2,Y              NEW THREAD PTR
          BRA    NEXT

RETURN:   PULS   Y                RECOVER OLD THREAD PTR
          BRA    NEXT
```

Listing 6: *A more complex direct-threaded code interpreter for the MC6809 microprocessor. Execution of the intermediate-language subroutine starts at the label ENTRY.*

```
           s ->next
               thread ptr 1
               thread ptr 2

RETURN:    LEAS   2,S          DISCARD "NEXT"
           PULS   Y            GET SAVED THREAD PTR

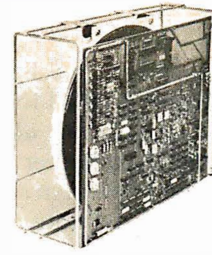
N1:        BSR    N2           PUSH ADDR OF NEXT
           s ->thread ptr 2
NEXT:      BRA    N1           SET UP RETURN TO NEXT
N2:        JMP    [,Y++]       GO TO ROUTINE

           s -> next
                thread ptr 2


      I-Code Routine  (start at ENTRY)

          PSHS   X             SAVE X
           s -> x
               thread ptr 0
               space
               next
               thread ptr 1
               thread ptr 2
          LDX    6,S           GET ADDR OF "NEXT"
          STX    4,S           MOVE IT
          STY    6,S           SAVE OLD THREAD PTR
           s ->x
              thread ptr 0
              next
              y (old thread ptr)
              thread ptr 1
              thread ptr 2
          PULS   X,Y           RECOVER X, NEW THREAD PTR
          JMP    [,Y++]        DO SIMPLE "NEXT"
ENTRY:    LEAS   -2,S          MAKE SPACE
          BSR    *-14        PUSH NEW THREAD PTR, GOTO PSHS X
     0:   _____                START OF THE IL CODE
          _____
          _____
          FDB    RETURN        ADDR OF "RETURN"
```


PRIAM Hard Disks Now Available from SIRIUS SYSTEMS!



PRIAM's high-performance, low-cost Winchester disc drives speed up throughput and expand data storage from 20 megabytes to 154 megabytes. And a single controller can be used to operate 14-inch-disc drives with capacities of 33, 66, or 154 megabytes or floppy-disc-size drives holding 20 and 34 megabytes. So it's easy to move up in capacity, or reduce package size, without changing important system elements or performance.

- *Fast, Linear Voice Coil Positioning*
- *10 ms track-to-track positioning*
- *Fully servoed head positioning*
- *Dedicated servo tracks*
- *DC Power required only!*
- *Simple, parallel Interface*
- *Optional SMD Interface*
- *50 ms Average Positioning time*
- *90 ms Maximum Positioning Time*
- *6.4 ms Average Latency*

THE PRIAM LINEUP

Model/Disc Size	Capacity	Size	Weight	Price
DISKOS 3350 (14")	33Mbytes	7" × 17" × 20"	33 lbs.	$2995
DISKOS 6650 (14")	66 Mbytes	7" × 17" × 20"	33 lbs.	$3749
DISKOS 15450 (14")	154 Mbytes	7" × 17" × 20"	33 lbs.	$4695
DISKOS 2050 (8")	20 Mbytes	4.62" × 8.55" × 14.25"	20 lbs.	$2995
DISKOS 3450 (8")	34 Mbytes	4.62" × 8.55" × 14.25"	20 lbs.	$3745
DISKOS 570	5.3 Mbytes	floppy-size	(low)	(low)
DISKOS 1070	10.6 Mbytes	floppy-size	(low)	(low)

All PRIAM DISKOS Drives have a Transfer Rate of 1.03 Mbytes/Sec.
Optional SMD interface available for $150.

SIRIUS SYTEMS offer cases and enclosures for all PRIAM Hard Disk Drives. All 14" Winchester Drives will mount in our 14" Standard Case. The 8" Winchesters have two alternatives: a single drive case and a dual drive case. All SIRIUS SYSTEMS Winchester drive cases include Power Supply, internal cabling, switches, fan, extra AC outlet (not switched, but fused) and possess very adequate ventilation. Drive addressing is done on the rear of the Case and not on the drive iteself to provide ease of use during operation. All WINCHESTER DRIVE Cases are Warranted for a full year and come in our standard blue-black color scheme. Consult us for current availability and pricing.

Remex RFD 4000/4001 8" Floppy Disc Drives Double sided... Double density!!

$549.95

RFD 4001, $569.95

Offers quality and features found in drives costing much more! ■ Single or Double Density ■ Double-Sided Drive ■ Door Lock INCLUDED ■ Write-Protect INCLUDED ■ 180 Day Warranty ■ Compatible with Shugart 850/851 ■ Low Power Operation ensures LONGER LIFE!! ■ Model RFD 4001 offers Data and Sector Separator

RFD 4000/4001 Technical Manual **6.95**
Connector Set #3 (AC, DC, Card Edge) .. **10.95**
Connector Set #4 (AC and DC) **2.95**
RFD 4000C/B Cabinet (for use with Power Modules) **29.95**

Remex 1000B... If you've been looking for a less expensive floppy disc drive, but not wanting to sacrifice quality — this is it!

$419.95

You get both in the Remex 1000B! For only $419.95 look at what you get: ■ 8" Floppy Drive ■ Single or Double Density ■ Hard or Soft Sectoring ■ Media Protection Feature ■ Single Density Data Separator ■ 180 Day Factory Warranty

Door Lock Option **$19.95**
Interface Adapter (REMEX-to-Shugart) ... **$14.95**
Write Protect Option **$19.95**
Connector Set #1 (AC, DC, & Card Edge) .. **$10.95**
RFD 1000B Technical Manual . **$5.95**
RFD 1000B CASE (for use with Power Modules) **$29.95**

SIRIUS 8" DISK POWER MODULES

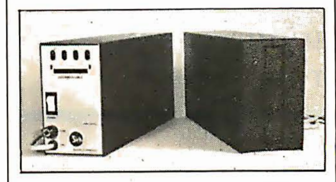
The Single and Dual Drive Power Modules are designed to provide DC and (switched) AC power for one (the Single Drive Power Module) or two (the Dual Drive Power Module— the DDPM will power three RFD 4000s or 4001s) 8" Floppy Disk Drives. Many features are included for safe and reliable operation and the Power Modules come with our standard 180 day WARRANTY (the Open Frame Power Supply warranty is for 2 years). All Power Modules will work with either the RFD 4000C/B or RFD 1000B case (color schemes match also).

Dual Drive Power Module (DDPM) **$139.95**

Single Drive Power Module (SDPM) **119.95**

SIRIUS 80+

Perfect Add-Ons for Your Computer System!



The SIRIUS SYSTEMS 80+ Series of Floppy Disk add-ons are designed to provide unmatched versatility and performance for your computer. Consisting of four different add-ons, there is a 80+ Series Floppy Disk to meet your need. All 80+ Series Floppy Disk are compatible with the TRS-80* and come ready to plug in!

COMMON CHARACTERISTICS

- *5 ms track-to-track access time*
- *Auto-eject*
- *180 day WARRANTY*
- *Exceptional speed stability— 1½%*
- *Single density (FM) or double density (MFM/M²FM)*
- *Ultra high reliability*
- *2 year Power Supply Warranty*
- *Mix any or all 80+ Series on the same cable!*
- *Includes user accessible plugboard for drive reconfiguring*

SPECIFIC CHARACTERISTICS

The **SIRIUS 80+1** is a single sided, 40 track, highly reliable Floppy Disk add-on. Offering 5 more tracks than the Radio Shack model, it cost $140 less! Formatted data storage is 102K/20K bytes single/double density.

SIRIUS 80+1 .... **$359.95**

The **SIRIUS 80+2** is a dual sided, 70 track (35 per side), highly versatile Floppy Disk unit. It appears to the TRS-80* as TWO 35 track drives, yet COST LESS THAN HALF THE PRICE! Even greater savings result, since data is recorded on both sides of the media instead of only a single side. Using the plug board, it may be reconfigured for other computer systems! (The 80+2 operates as Drive 0 and any of the other three addresses (with the sandard Radio Shack Cable) or as any of four drives (with the SS Standad Cable).) Formatted data storage is 80.6K/161.2K bytes single/double density.

SIRIUS 80+2 .... **$449.95**

The **SIRIUS 80+3** is a single sided, 80 track, "Quad" density Floppy Disk unit. Offering 2⅓ times the storage of a Standard Radio Shack drive, the 80+3 greatly reduces the need for diskettes correspondingly. Additionally, because of the increased storage and faster track-to-track access time, the 80+3 allows tremendously increased throughput for disk based programs!!! The 80+3 INCLUDES SIRIUS's TRAKS-PATCH on Diskette. Formatted data storage is 204K/40K8 bytes single/double density.

SIRIUS 80+3 .... **$489.95**

The **SIRIUS 80+4** Floppy Disk add-on is a double sided, 160 track (80 per side), 5¼" monster! The ultimate in state-of-the-art 5¼" Floppy Disk technology, to 80+4 is seen by the TRS-80* as two single sided disk drives, each with 80 tracks. Thus, in terms of capacity one 80+4 is equivalent to 4⅔ standard Radio Shack drives — a savings of over 73% (not to mention diskettes!!!). (With a double density converter, the available memory is huge!) The 80+4 is similar to the 80+2 in that it arrives configured as Drive 0 and any of the other three addresses (with the standard Radio Shack Cable) or as any of four drives (with the SS Standard Cable). The 80+4 INCLUDES TRAKS-PATCH on Diskette. (The plug board is also included.) Formatted data storage is 408K single density or 816K bytes double density.

SIRIUS 80+4 .... **$624.95**

All 80+ Series Floppy Disk add-ons operate a 5 milliseconds track-to-track access time (eight times faster than the SA 400) but are Expansion Interface Limited to 12 milli-seconds for the TRS-80*.

*TRS-80© Tandy Corp.

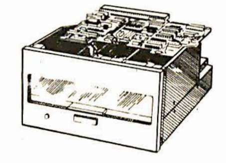
MPI 51/52...

A Great Reliable Mini-Drive!

- *Fast! 5ms track to track access*
- *Exclusive Pulley-Band Design*
- *Unique Door/Ejector Mechanism*
- *Reliable 1½% Speed Stability*
- *Single/Double Density Operation*
- *Industry/ANSI Standard Interface*

MPI 51
(Single Head, 40 tracks, 120K/240K bytes Single/Double Density**) **$259.95**

MPI 52
(Dual Head, 70 tracks, (35/side), 218.8K/437.5K Single/Double Density**) **$349.95**



MPI 91/92... NEW STATE-OF-THE-ART DISK DRIVE!

MPI 91
(Single Head, 80 tracks, 240K/480K Single/Double Density**) **$389.95**

MPI 92
(Single Head, 160 t acks (80/side), 480K/960K Single/Double Density**) **$499.95**

***Unformatted data storage*

Introducing the Versatile, Low-Cost OMEGA Series Controller

As new technological advances bring down the cost of fast, reliable mass data storage, the need for an inexpensive, versatile controller have become greater and greater. To meet this need, SIRIUS SYSTEMS' OMEGA Series Controller was designed.

The SIRIUS OMEGA Series Controller Module utilizes an **on-board microprocessor** to mediate data transfer to a wide variety of peripherals from an equally wide variety of host computer systems. Up to four Winchester Hard Disks (8" or 14"), four 5¼" Floppy Disks Drives and/or up to eight 8" Floppy Disk Drives may be **in use at one time.** Host systems interfacing is accomplished via a parallel or a serial interface. With the additon of a Personality module, the OMEGA Series Controller Module is directly **compatible with many popular computer systems** (among them the TRS-80*, Apple, Heath, and others). Provision is made for the addition of a streaming tape drive, also.

SPECIFIC HARDWARE FEATURES INCLUDE:

- *Control of up to twelve Floppy Disk Drives (eight 8" and/or four 5¼")*
  - *8" and/or 5¼" Disk Drive Utilization*
  - *Single (FM) or Double (MFM) density data storage*
  - *Hard or Soft sectored diskette usage*
  - *Utilization of "Quad" density (96 tpi) 8" or 5¼" Disk Drives*
- *Control of up to four WINCHESTER type PRIAM DISKOS Disk Drives*
  - *8" or 14" may intermix on the same cable*
  - *Accommodates 8" and/or 14" drives of 5.3Mbytes to 154Mbytes*
  - *Ultra-Fast data transfers*
- *Extremely flexible host-controller interfacing*

SPECIFIC SOFTWARE FEATURES INCLUDE:

- Dynamic format modifications via command words
- Extremely flexible format acceptance for unusual data storage formats
- Easily interfaces to standard operating systems (TRS-DOS*, CP/M***, etc)
- Operates in either get/put sector mode or data string mode
- Performance parameters may be changed by EPROM replacement or Dynaminic Reprogramming

Dedicated systems cards are also available on a limited basis for the STD-BUS and the S 100. These cards feature shared memory also (again, software selectable) in addition to the regular OMEGA Series Controller Module features. Consult SIRIUS SYTEMS for current price and availability for the entire line of OMEGA Series Memory Units and Controllers. **Dealer inquiries are invited.**



SIRIUS SYSTEMS
7528 Oak Ridge Highway
Knoxville, Tennessee 37921

TO ORDER CALL (615) 693-6583

Phone Orders Accepted 9AM-7PM (ESDT)

We accept **MC, VISA, AE, COD** (requires Certified Check, Cashier's Check or Cash) and **Checks** (personal checks require 14 days to clear). **SHIPPING AND HANDLING:** $7 00 per Floppy Disk Drive or 80+ Module ■ 5% for other items (any excess will be refunded) ■ **Foreign Orders** add 10% for Shipping & Handling. Payment in U S .currency ■ Tennessee residents add 6% Sales Tax ■ **VOLUME DISCOUNTS AVAILABLE**

Circle 135 on inquiry card.

> Software can be written to function properly on widely varying computers that use the same microprocessor.

pendent of particular programmable memory locations.

Another way to eliminate the use of processor resources, as well as maximize throughput, is to use subroutine-threaded code (STC). Subroutine-threaded code makes use of only the program counter and the subroutine return stack, resources already dedicated to the control of program flow. Thus, the processor resources traditionally available to the programmer remain free for use by machine-language code.

Distribution of Software

It is possible to conceive of a mass market for software; such a market would allow high-quality programs to be distributed at low cost. We will assume that such code will be distributed in the form of read-only memory modules, so that a purchaser actually receives a physical product for his money. Furthermore, the memory needed to store the program is included in the purchase price, a characteristic not obtained with distribution on magnetic media. Software piracy will be possible for advanced hobbyists, but these represent only a small portion of the consumer market.

To maximize sales, it is necessary that everyone who has a computer and who wants to use the program be able to do so. Given machine-language distribution, the market is already limited to those users with a particular processor; it should not also be limited to those users with a particular computer system.

Software can be written such that it functions properly on systems that use different locations for programmable memory, read-only memory, and input/output (I/O) devices, as well as systems that use completely different I/O devices. The system-independent read-only memory must be written in code that is position independent, and it must also include features for linking to other similar modules. These criteria can be satisfied with machine-language code (on certain processors) or with a correctly designed intermediate language. Widest distribution requires such properly written code.

Machine-Language Examples of Threaded-Code Interpreters

Here we present assembly-language code for the Motorola MC6809 microprocessor which implements complete interpreters for direct-threaded code, indirect-threaded code, and token-threaded code. Most of these listings are punctuated by "stack pictures" (typed in lowercase) that represent the current state of the stack at various points in the listing; visualization of the stack is often crucial to understanding the interpretive process.

An illustration of subroutine-threaded code (using subroutine jump and return instructions) would be trivial, and thus is not included. However, it should be noted that a position-independent form of subroutine-threaded code is available on computers with long rela-

CP/M Ver. 9.00 is one 16 K core program using random access releasing both drives for data storage, and 250 word vocabulary is translatable in any foreign language.

Is Expandability the Reason Over 200,000 Smart Buyers Chose TRS-80? Or is it Price? Or . . .

Maybe these customers came to Radio Shack for their computer because they knew they could get nationwide service? Or buy a Model I micro starter system for $499? Or because Radio Shack started the boom in reliable little computers? But come they did. And coming they still are!

"Who Wants One That Can't Grow?"

This question was asked by Radio Shack's president before TRS-80™ went to market. So we made memory expandable from 4K to 48K RAM (in 16K leaps). We made ROM expandable and BASIC upgradable. We provided for the addition of disk drives, printers, acoustic couplers and other peripherals. We have a great new upper/lower case conversion, and a SCRIPSIT™ package that makes TRS-80 Model I a great bargain in Word Processing.

"Be Better Than Competition!"

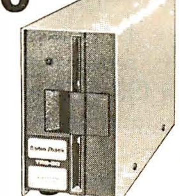
"Not merely cheaper," he said, "not just more popular," he said. "Better!" That includes software, hardware, service, monitor size, keyboards, salesmen, store fronts, peripherals and RAMs. If you own a TRS-80, let us show you how to better your system and its benefits. If you're still on the sidelines . . . shouldn't you play with us? After all, Radio Shack and TRS-80 have FAST DELIVERY FROM STOCK or a very short wait. Most (if not all) the competitors are much slower players!



Expansion Interface

The hub of an expanded TRS-80 system. Holds up to 32K more memory! Has interfaces for printer, 4 disk drives, second cassette. Also takes RS-232C interface card. $299

Save $100.00



Mini-Disk Drives

Reg. $499 **$399 each**

Quality engineered disk drives let you store and retrieve data and programs fast. Sale ends 9/30/80. Order Today!



Line Printer II

Quality for less! Prints 100 cps on 80 columns. Accepts 9⅞" fan-fold, 8½" roll paper or single sheets. $799

FOR MORE REASONS SEND FOR OUR FREE COMPUTER CATALOG

NAME ______________________

STREET ______________________

CITY __________ STATE ______ ZIP ______

81-A-1 (BYTE)

Radio Shack®

The biggest name in little computers™

A DIVISION OF TANDY CORPORATION, FORT WORTH, TEXAS 76102

Some computer equipment may require special order.

Retail prices may vary at individual stores and dealers.

tive branch instructions (eg: the LBSR, long branch-to-subroutine, and RTS, return-from-subroutine, instructions on the MC6809).

Listing 4 illustrates a very simple implementation of a direct-threaded code interpreter. This particular implementation is very fast, but it has the following undesirable properties:

- it requires a special machine-language return instruction (ie: JMP [,Y++]);
- it reserves the Y register for use by the interpreter;
- it requires that the interpreter location (the address of RETURN) be known to the compiler, making the resulting intermediate-language code definitely position-dependent.

In operation, the Y register points to the next address in a direct-threaded code list; that address, of course, points directly to machine code. Executing the operation JMP [,Y++] (indirect, autoincrement by 2) causes the machine to start execution at the address contained in the list element; simultaneously, the Y register is updated to point at the next item in the list of addresses.

The single instruction JMP [,Y++] ends each machine-language subroutine. By reserving a processor register for use as the current thread pointer, a speed advantage is obtained; transfer of control using JMP [,Y++] requires nine machine cycles (on the MC6809), while a JSR-RTS pair requires thirteen.

The situation becomes more complex when control is transferred to a subroutine composed of intermediate-language statements. Machine-language instructions are included at the beginning of the intermediate-language subroutine to perform the *call* operation. The Y register may be thought of as the topmost location of the stack of intermediate-language return addresses; its contents are pushed onto the stack, and Y is loaded with the address of the start of the intermediate-language subroutine list.

The last item in an intermediate language list is the address of the *return* routine. This recovers an old intermediate-language pointer from the stack and continues interpretation where it left off when it did a subroutine call.

In listing 5, we show a very simple indirect-threaded code interpreter. As in the previous example, the interpretation process is fast, but again it has the following limitations:

- it must use a position-dependent, machine-language return instruction (eg: JMP NEXT);
- it uses the Y register to hold the list pointer;
- it still requires that the compiler generate position-dependent pointers to the CALL and RETURN routines.

Listing 6 is an example of a moderately complex direct-threaded code interpreter. It is somewhat slower than the simple interpreter in listing 4, but it uses a standard RTS instruction to return from machine-language routines. Thus, the machine-language routines need not contain pointers to the *next* operation. Still, this advantage is bought at the expense of additional machine-language code in each intermediate-language subroutine. The intermediate-language subroutines themselves do have

Listing 7: *An improved direct-threaded code interpreter for the MC6809 microprocessor. This interpreter does not use any of the microprocessor registers.*

```
          s ->ptr to new thread
              addr of "next"
              old thread ptr

 CALL:    PSHS D              SAVE D
          LDD 2,S             GET NEW PTR
          STD 4,S             THREAD PTR

          s ->d
              space
              new thread ptr
              old thread ptr

          PULS D              RECOVER D
          LEAS 2,S            DELETE SPACE
 NEXT:    LEAS -4,S           MORE SPACE

          s ->space
              space
              thread ptr

RETURN:   PSHS X,D            SAVE X, D

          s ->d
              x
              space
              space
              thread ptr

          LDX 8,S             GET THREAD PTR
          LDD ,X++            GET NEXT MACHL ADDR
          STX 8,S             STACK THREAD PTR
          STD 4,S             STACK ROUTINE ADDR
          LEAX NEXT,PCR       GET ADDR OF "NEXT"
          STX 6,S             SAVE AS MACHL RETURN

          s ->d
              x
              machl routine
              addr of "next"
              thread ptr

          PULS D,X,PC         GO TO MACHL ROUTINE

          s ->addr of "next"
              thread ptr


 I-CODE:   JSR CALL <instl> ... <RETURN>
```

Listing 8: *Token-indirect token-threaded interpreter for the MC6809 microprocessor. Because of the use of two levels of lookup, this interpreter is completely position independent.*

```
        s -> table addr
             old indirect
             thread ptr

NEXT:   LEAS  -4,S          MAKE FREE STACK SPACE
        PSHS  U,X,D         SAVE REGISTERS

        s -> d
             x
             u
             space
             space
             table addr
             indirect
             thread ptr
```

Listing 8 continued on page 222

Listing 8 continued:

```
LDU   10,S          GET TABLE ADDR
LDX   14,S          GET THREAD PTR

LDB   ,X+           GET INDIRECT TOKEN
STX   14,S          SAVE THREAD PTR
CLRA                :
ASLB                : TWO BYTES PER TOKEN
ROLA                :
LDX   D,U           TABLE-RELATIVE INDIRECT PTR
ADDD  4,S           NOW ABSOLUTE
TFR   D,X

LDB   ,X+           GET TOKEN
STX   12,S          SAVE INDIRECT PTR
CLRA
ASLB
ROLA
LDD   D,U           TABLE-RELATIVE MACHL ADDR
ADD   4,S           NOW ABSOLUTE
TFR   D,X

STX   6,S           SAVE AS UPCOMING PC
LEAX  NEXT, PCR     ADDR OF NEXT
STX   8,S           SAVE FOR MACHL RTS
PULS  D,X,U, PC     RECOVER REGS + GO!


s -> addr of "next"
     table addr
     indirect
     thread ptr

  CALL:   PSHS  D          SAVE D

          s -> d
               addr of "next"
               table addr
               indirect
               thread ptr

          LDD   4,S        GET TABLE ADDR
          STD   2,S        MOVE IT
          PULS  D          RECOVER D
          BRA   NEXT

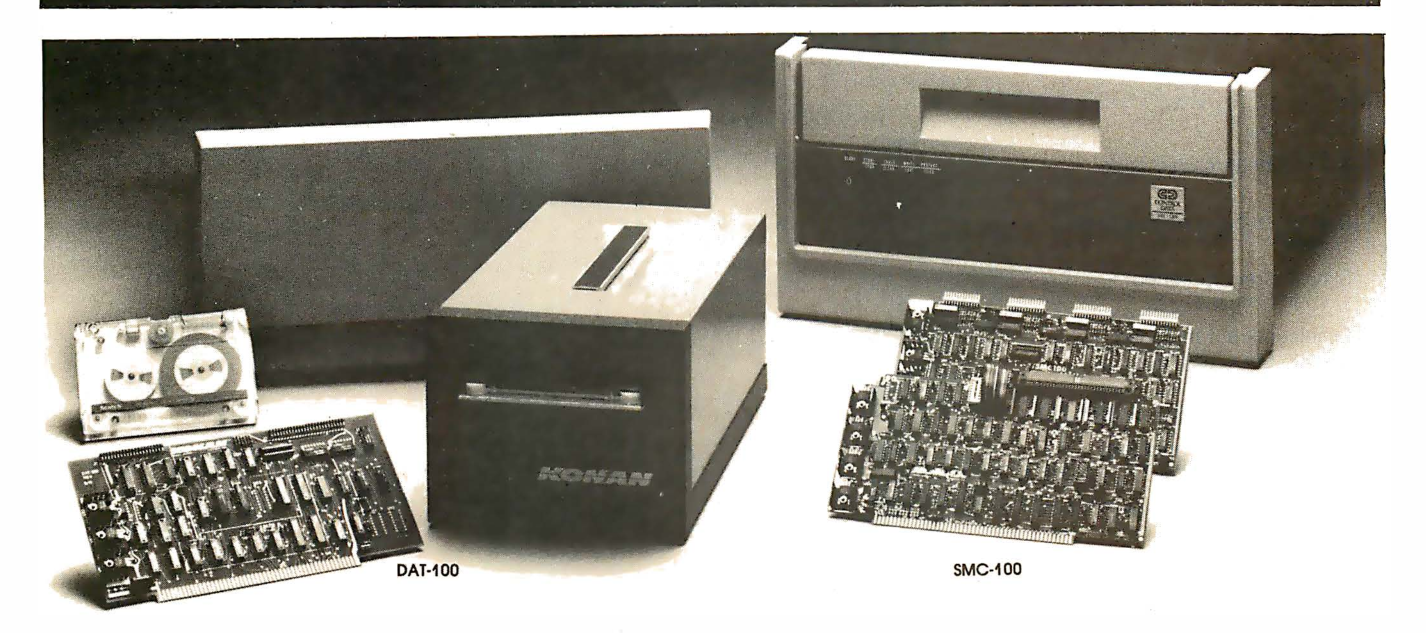
RETURN:   PSHS  D          SAVE D

          s -> d
               addr of "next"
               table addr
               old indirect
               thread ptr 1
               thread ptr 2

          LDD   4,S        GET TABLE ADDR
          STD   6,S        MOVE IT
          LDD   0,S        RECOVER D
          LEAS  6,S        DISCARD JUNK
          BRA   NEXT
```

pointers to the *return* operation, of course (making the code position-dependent), and the interpreter reserves the Y register for its own use.

Listing 7 illustrates a direct-threaded code interpreter that does not reserve any processor registers; this interpreter also allows the return from machine-language routines by means of a standard RTS instruction. The absolute locations of the interpreter *call* and *return* routines must be included in each direct-threaded code subroutine; this usually precludes the distribution of such subroutines in read-only memory.



Hard disk and hardtape™ control

Up to 2400 Megabytes of hard disk control for the S-100 bus.

Konan's SMC-100 interfaces S-100 bus micro computers with all hard disk drives having the Industry Standard SMD Interface. It is available with software drivers for most popular operating systems. Each SMC-100 controls up to 4 drives ranging from 8 to 600 megabytes per drive, including most "Winchester" drives -- such as Kennedy, Control Data, Fujitsu, Calcomp, Microdata, Memorex, Ampex, and others.

SMC-100 is a sophisticated, reliable system for transferring data at fast 6 to 10 megahertz rates with onboard sector buffering, sector interleaving, and DMA.

SMC-100's low cost-per-megabyte advanced technology keeps your micro computer system micro-priced. Excellent quantity discounts are available.

Konan's HARDTAPE™ subsystem . . . very low cost tape and/or hard disk Winchester backup and more.

Konan's new DAT-100 Single Board Controller interfaces with a 17½ megabyte (unformatted) cartridge tape drive as well as the Marksman Winchester disk drive by Century Data.

The DAT-100 "hardtape" system is the only logical way to provide backup for "Winchester" type hard disk systems. (Yields complete hard disk backup with data verification in 20-25 minutes.)

Konan's HARDTAPE™ subsystem is available off the shelf as a complete tape and disk mass storage system or an inexpensive tape and/or disk subsystem.

Konan controllers and subsystems support most popular software packages including FAMOS™, CP/M® version 2.X, and MP/M.

Konan, first (and still the leader) in high-reliability tape and disk mass storage devices, offers OEM's, dealers and other users continuing diagnostic support and strong warranties. Usual delivery is off the shelf to 30 days with complete subsystems on hand for immediate delivery.

Call Konan's TOLL FREE ORDER LINE today:

800-528-4563

Or write to Bob L. Gramley
Konan Corporation, 1448 N. 27th Avenue
Phoenix, AZ 85009. TWX/TELEX 9109511552

CP/M® is a registered trade name of Digital Research.
FAMOS™ is a trade name of MVT Micro Computer Systems.
HARDTAPE™ is a trade name of Konan Corporation.



Circle 139 on inquiry card.

Type of Threaded Code	MC6809 Machine Cycles Used	Ratio of Cycles Used	Relative Size of Resulting Intermediate-Language Code	Can this Code Be Marketed to All Users of a Given Microprocessor?
Subroutine-threaded code	91	1.0	3	no
Relative subroutine-threaded code	98	1.1	3	yes
Simple direct-threaded code (listing 4)	93	1.1	2	no
Simple indirect-threaded code (as in listing 5)	371	4.1	2	no
Moderately complex direct-threaded code (as in listing 6)	228	2.5	2	no
Improved direct-threaded code (as in listing 7)	552	6.1	2	no
Token-threaded code (as in listing 8)	1083	11.9	1	yes

Table 1: *Comparison of threaded-code techniques. Notice that only two forms of threaded code, the relative subroutine-threaded code and the token-indirect token-threaded code are sufficiently system-independent to be used for mass distribution to (potentially) all users of a given microprocessor.*

A possible alternative would be to modify the direct-threaded code interpreter in listing 7 to use strictly self-relative pointers. Then by including code for *call* and *return* in each read-only memory device, a form of distributable direct-threaded code might be obtained. However, because the read-only memory still contains machine-dependent code, the use of direct-threaded code in a read-only memory environment offers little advantage.

The improved direct-threaded code interpreter allows the use of most previously coded machine-language modules and allows these routines to pass parameters through the processor registers. Routines cannot pass parameters on the hardware stack (which is used to maintain the state of the interpreter), but could easily use the user stack of the MC6809 microprocessor for parameter transfer.

A similarly improved interpreter could be built for indirect-threaded code, but the position-independence problem is inherent in this intermediate language as well. Each indirect-threaded subroutine must include a pointer to the *call* routine, thus making the resulting intermediate-language code unsuitable for distribution in read-only memory.

However, it *is* possible to build a token-thread interpreter that has a completely position-independent intermediate-language representation. Listing 8 shows one implementation that achieves these goals. Notice the increased complexity and overhead when compared to our original direct-threaded code interpreter.

This token-thread interpreter produces intermediate-language code that is more compact than that produced by previously mentioned interpreters. The advantage of a compact representation need not affect execution speed severely; remember that the overall efficiency of any interpretation scheme (including the hardware interpretation of op codes) depends more upon the work actually accomplished than the time spent in the interpretation process itself.

This particular implementation is essentially a token-indirect token-thread interpreter. Two levels of token lookup are involved so that neither machine-language nor absolute addresses need be included as part of the intermediate-language subroutine. Of course, perhaps

SAVE / on Software and Hardware for TRS-80® and Apple®

NEWDOS/80

A new enhanced NEWDOS for the TRS-80.

The most powerful Disk Operating System for the TRS-80 designed for the sophisticated user and professional programmer who demands the ultimate.

NEWDOS/80 is the planned upgrade from NEWDOS 2.1. Some of the features are:

- New BASIC commands for files with variable record lengths up to 4095.
- Mix or match drives. Use 35, 40 or 77 track 5" disk drives or 8" disk drives, or combo.
- Security boot-up for BASIC or machine code application programs.
- New editing commands.
- Enhanced RENUMber that allows relocation.
- Command chaining.
- Print Spooler.
- DFG function; striking of D, F and G keys allows user to enter a mini-DOS without disturbing program.
- Compatible with NEWDOS & TRSDOS.
- Machine language Superzap/80, 2.1 utilities and enhanced copy by file commands.
- Enter debug any time by pressing 123 keys. Also allows disk I/O.
- Diskette "Purge" command.
- Specifiable system options (limited sysgen type commands).
- Increased directory capacity.

$149

APEX

A new disk operating system for the Apple.

Fully Professional DOS for the Apple II. The result of two years of extensive development, APEX provides a complete program development and file management system, both powerful and useable. A comprehensive command set allows the user to perform almost any imaginable disk operation. Here are some of APEX's features:

- Command structure similar to CPM and main frame systems. Contains 20 command words, with ability to treat external programs as transient commands to the operating system.
- Scrolling editor compatible with Videx 80 char. card.
- Easy program interface. Simple communications between the DOS and user program.
- Capable of handling 5 inch, 8 inch and hard disks.
- Safety features to protect against accidental data loss. Features include backup files, directory, read-after-write and limit checks.
- 4 times faster than CPM.
- Auto default structure eliminates tedious typing by automatically setting up command strings, file names, etc.
- Functional on both single and multi-drive systems. Includes utilities for file copy.
- Device handler structure for interfacing peripherals.

The APEX package includes all of the tools for a complete assembly language development system, high speed two pass resident assembler and a powerful macro editor.

The complete APEX package with operating system, assembler, editor and manuals also includes utilities to maintain files on single or multiple drive systems.

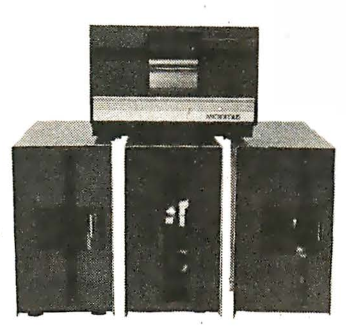
$99

Related Software
XPLØ $79
FOCAL™ $59

Disk Drive Sale!

$70 worth of FREE merchandise with purchase of Shugart SA400 with power supply and chassis, the disk that Radio Shack sells for $499.

SAVE $200.	$369
TF-Pertec FD200, 40 track, use both sides.	$389
TF-5 MPI B51, 40 track	$389
TF-70 Micropolis, 77 track with 195K storage.	$639
TDH-1 Dual Sided drive, 35 track.	$499
NEWDOS+, 40 track	$110
35 track	$ 99
Business Programs (Interactive A/R, A/P, & GL)	$349
Radex Data Base Program	$ 99
Mailing List	$59



Disk Drive Expansion System

	List Price
• 2 Shugart SA400 drives with power/chassis	$ 738
• 1 Two-Drive Cable	$ 25
• 1 Expansion Interface 32K	$ 499
• 1 35-track DOS+	$ 99
TOTAL LIST PRICE	$1,361
SPECIAL PRICE ONLY	$1,199

MOD I 8" Disk System
- One SA800R Floppy
- 2 Drive Chassis and Power Supply
- DOS and Cable **$1,095**

MOD II 8" Disk System
- 3 Drive Chassis
- 2 Drive Expansion System **$1,399**
- 3rd Drive ... **Add $479**

More Savings

Drives for any microcomputer

Does not include power supply & cabinet.

Pertec FD200	$ 282	FD250	$ 399
Shugart SA400	$ 279	SA800/801	$ 479
MPI B51	$ 279	B52	$ 349

PRINTERS

Centronics 779	$1,069
Base 2	$ 599
Centronics 737 Text processing capabilities, lower case descenders, underlining, subscripts and superscripts, 80 cps	$899



Spinwriter **$2,549**



NEW SALE PRICE

TRS-80 Graphics, Okidata Microline 80...

List $949
Our price **$699**

Save on Apple II 16K
FREE memory upgrade kit to 48K with purchase of Apple II 16K **$1,195**

Introductory Offer—
Mini-Floppy for Apple (2nd Drive) ... Only **$419**

Apple 8" Disk System • One SA800R Floppy
- 2 Drive Chassis & Power Supply
- Controller, Cable and DOS **$1,449**

16K Memory Upgrade Kits .... **$ 79**

0/2A



Apparat, Inc.
(303) 741-1778
4401 S. Tamarac Pkwy. • Denver, CO 80237 • (303) 758-7275

MTI MICROCOMPUTER TECHNOLOGY INCORPORATED
3304 W. MacArthur • Santa Ana, CA 92704 • (714) 979-9923



All prices cash discounted / Freight: FOB factory. Ask for our free catalog.

other, more advantageous forms of token-threaded code interpreters are possible. However, we have shown that there is no longer a question whether position-independent threaded code is possible; now the question is: "at what cost?"

The Cost of Implementation

The claims made for threaded-code techniques in an intermediate-language implementation include reduced program storage and high speed of execution. Unfortunately, these claims are justified only in certain limited contexts. The original implementations of threaded code, which occurred on the Digital Equipment Corporation PDP-11, made use of the instruction JMP @(Rn)+ ; this instruction jumps through a memory pointer while retaining the location of *next* in a register. This is equivalent to the MC6809 instruction JMP [,r++] .

The instruction JMP @(Rn)+ does not save a return address on a memory stack and thus is faster than a JSR instruction. In the environment of a single intermediate-language program that calls only machine-language subroutines, stacking and unstacking of the return address need not occur. Of course, when intermediate-language programs call intermediate-language subroutines, such stacking must occur in a process that will take *longer* than a normal JSR. Thus, for maximum speed, the threaded-code intermediate-language program should not call intermediate-language subroutines.

On the other hand, the instruction JMP @(Rn)+ does eliminate the in-line 16-bit JSR op code for a 50% code reduction (on the PDP-11). But the 50% code reduction achieved on the PDP-11 (which uses a 16-bit JSR op code) is only a 33% code reduction on most microcomputers, which have 8-bit JSR op codes. (The LBSR instruction can be used in the case of the MC6809.) And if the motivation for threaded code is reduction of the intermediate-language code size, token-threaded code implementations can improve the storage efficiency by *another* 50%.

The two traditional forms of threaded code (direct and indirect) are optimized for the environment of a particular computer architecture that is represented by the PDP-11 (and also reflected in the MC6809). Consequently, many microcomputer threaded-code implementations have provided neither maximum code efficiency nor maximum speed and have devoured virtually all of the machine-level microprocessor resources. Comparisons of the four types of threaded code demonstrate that it is unlikely that the speed and code-efficiency maxima will ever coincide.

The main factor affecting code compaction is the use of subroutines instead of in-line code; but the use of subroutines inherently increases interpretation overhead. Since all methods of threaded-code implementation allow the use of subroutines, effects due to the use of subroutines can be disregarded and the efficiency of the implementation methods can be compared directly. Table 1 shows this comparison with values from the machine-language routines developed earlier (based on six *next* operations for each *call* and *return* operation).

Conclusions

Languages that have been historically associated with threaded code will probably continue to use these techniques when implemented on microcomputers. New implementations should take advantage of the interpretive nature of threaded code to provide extensive debugging facilities. However, there is no excuse for the threaded-code implementor to prohibit the use of previously coded machine-language modules by eliminating parameter passage through microprocessor registers. Either the interpreter can be designed to keep these registers free, or special routines must be written by the implementor to save and restore these registers when using library routines stored in read-only memory.

Similarly, the motivation for distributing software in an open market (to many different users with many different systems) leads directly to the requirement for position independence. While the MC6809 directly supports position-independent code at the machine-language level, it is also possible to devise threaded-code intermediate languages that are position independent. But any intermediate language or interpreter that requires particular absolute storage locations is so obnoxious as to be unworthy of discussion in polite programming society. Absolute-address storage requirements are simply unacceptable in code written for mass distribution.

Within these constraints, the various forms of threaded code offer different trade-offs of speed and code efficiency. Because these forms are logically equivalent, a single compiler could be used to generate any of them at the user's choice. Thus, without changing the source program, a threaded-code technique could be selected that would give the desired trade-off between speed and code efficiency for a particular situation.

In the end, threaded-code implementation techniques

are neither particularly compact nor are they particularly fast. Continued development of direct-threaded code structures could result in a language representation that would look more like Pascal p-code than threaded code. Threaded code does offer a conceptually simple and general control-transfer technique that displays a clear boundary between interpretation and language. However, threaded code is probably not an optimal representation for any particular language, including FORTH.■

Bibliography

1) Bartholdi, P, *Stepwise Development and Debuging (sic) Using a Small Well Structured Interactive Language for Data Acquisition and Instrument Control.* Copy received from the author. (Author's address: Observatoire De Geneve, CH-1290-Sauverny, Switzerland.)
2) Bell, James R, "Threaded Code," *Communications of the ACM,* volume 16, number 6, June 1973, pages 370 thru 372.
3) Dewar, Robert K, "Indirect Threaded Code," *Communications of the ACM,* volume 18, number 6, June 1975, pages 330 thru 331.
4) Dewar, Robert K and A P McCann, "MACRO SPITBOL—A SNOBOL4 Compiler," *Software Practice and Experience,* volume 7, number 1, 1977, pages 95 thru 113.
5) *fig-FORTH Installation Manual,* FORTH Interest Group, San Carlos CA, May 1979.
6) *FORTH Dimensions,* volume 1, numbers 1 to 4, FORTH Interest Group, San Carlos CA.
7) Gaebler, Robert F, "Make it Natural," *Electronics,* volume 52, number 14, July 5, 1979, page 6.
8) Grappel, Robert D, "STRUBAL vs FORTH," *Dr Dobb's Journal,* volume 3, number 8, September 1978, page 28.
9) Brinch Hansen, Per and C Heyden, "Microcomputer Comparison," *Software Practice and Experience,* volume 9, number 3, 1979, pages 211 thru 217.
10) James, John S, "FORTH Dump Programs," *Dr Dobb's Journal,* volume 3, number 28, September 1978, pages 26 thru 27.
11) James, John, "FORTH for Microcomputers," *Dr Dobb's Journal,* volume 3, number 25, May 1978, pages 26 thru 27.
12) Main, Richard B, "FORTH vs Assembly," *Dr Dobb's Journal,* volume 4, number 31, January 1979, pages 45 thru 47.
13) Meinzer, Karl, "IPS, An Unorthodox High Level Language," January 1979 BYTE, volume 4, number 1, pages 146 thru 159.
14) *MicroFORTH Primer.* FORTH Inc, Hermosa Beach CA, December 1976.
15) Moore, Charles H, "FORTH: A New Way to Program a Mini-Computer," *Astronomical Astrophysics Supplement,* volume 15, 1974, pages 497 thru 511.
16) Moore, Charles H, and Elizabeth D Rather, "The Use of FORTH in Process Control," *Proceedings of the International Mini-Micro Computer Conference,* Geneva, March 26, 1977.
17) Oliver, John P, "Astronomy Application for PET FORTH," *Dr Dobb's Journal,* volume 3, number 30, November and December 1978, page 46.
18) Phillips, J B, M F Burke, and G S Wilson, "Threaded Code for Laboratory Computers," *Software—Practice and Experience,* volume 8, 1978, pages 257 thru 263.
19) Rather, Elizabeth D, and Charles H Moore, "The FORTH Approach to Operating Systems," *ACM '76 Proceedings,* October 1976, pages 233 thru 240.
20) Rawson, Edward B, "Let it Be," *Electronics,* February 14 1980, volume 52, number 4, page 8.
21) Ritter, Terry F, and Joel Boney, "A Microprocessor for the Revolution: The 6809—Part 1: Design Philosophy," January 1979 BYTE, volume 4, number 1, pages 14 thru 42; "Part 2: Instruction Set Dead Ends, Old Trails and Apologies," February 1979 BYTE, volume 4, number 2, pages 32 thru 42; "Part 3: Final Thoughts," March 1979 BYTE, volume 4, number 3, pages 46 thru 52.
22) Roichel, Ancelme, "SAM76-FORTH-STRUBAL," *Dr Dobb's Journal,* volume 3, number 30, November and December 1978, pages 44 thru 45.
23) Sachs, John, *STOIC (Stack Oriented Interactive Compiler),* MIT and Harvard Biomedical Engineering Center, Cambridge MA, 1977.
24) Sirag, David J, "DTC Versus ITC for FORTH on the PDP-11," *FORTH Dimensions,* volume 1, number 3, June and July 1978, pages 25 thru 29.

New Cultures from New Technologies

Seymour Papert, Project LOGO, Massachusetts Institute of Technology, Artificial Intelligence Laboratory, 545 Technology Sq, Cambridge MA 02139

When I was asked to write this Education Forum for BYTE, I was in the process of correcting the proofs of my book, *Mindstorms: Children, Computers and Powerful Ideas*. (See reference 1.) There I struggled to present in two hundred pages a vision of a few ways in which computers might affect how children learn; it is challenging now to find the right 3000 *words* to convey something of the same vision. What images, what metaphors best capture for me the essence of the computer as it might enter the lives of children?

I start with an image, more general than the computer, that has helped me to think about how the world takes up any new technology. The first movies were made by setting the newly invented motion-picture camera in front of a stage where a play was performed just as plays always had been. Only after some time did cinema become more than theatre plus camera. When it did, what emerged was something original and unique, a whole new culture with new modes of thinking and new breeds of people—stars, directors, scriptwriters, cameramen, critics, and audiences whose sensitivities, expectations, and ways of seeing were quite different from those of the theatre-goers of the past.

So too with the computer. The first instinct of educators is to couple the new technology to their old methods of instruction. My vision is of something much grander. So I dream of using this powerful new technology not to "improve" the schools we have always known (and, to be honest, hated) but to replace them with something better. I do not believe that this something will look anything like what is now known as "computer-aided instruction" (CAI). I think it will be more like the growth of a new culture, a "computer culture" in which the presence of computers will have been so integrated into new ways to think about ourselves and about the subject matters we learn that the nature of learning itself will be transformed.

In thinking about the nature of such potential transformation, the LOGO group of the Massachusetts Institute of Technology (MIT) Artificial Intelligence Laboratory has been guided by the idea of creating computer-based environments in which mathematics and other areas of "formal" learning can be learned in a natural fashion, much as a child learns to speak; and applying concepts from artificial intelligence to children's learning, to help children become articulate about, and thus gain control over, the learning process. Before developing these ideas, I would like readers to clear their minds of a misleading but common image. People generally think about computers in schools as a scarce resource to which students have occasional access. It is time we learned to think in terms of a computer for every child, and we should think about children having access to computers from infancy. If we think in these terms, we begin to recognize that there is a clear discontinuity between the current ideas about using computers in schools and the situation of the future. I really believe that almost everything being done today is only relevant to the future in that it sets a bad example so that people become accustomed to primitive models.

A natural place to begin a search for "something new in education" is to look for examples of highly successful learning. For me the most dramatic image of successful learning is the way children learn to talk. This learning contrasts with school learning in many ways, of which I think two are most important. First, it is highly successful: all children learn to speak the colloquial dialect in which they grow up. Second, it has none of the technical paraphernalia of schooling—no curriculum, no set lesson times, no quizzes, no grades, no professional teachers. It is part of living. I call it learning-without-teaching or

NO IT ISN'T !!

NOT ANYMORE!

No this isn't a "Hard Disk". We used to call it that, sometimes. But somebody muddied the water.

"Hard Disk", unfortunately, now calls something else to mind. That little bitty guy with no backup capability and no way of switching media? It's a "Hard Disk" to work with, all right, in business applications. Some even say "Impossible Disk".

We'd like to avoid confusion between our Cameo database solution and the one that doesn't work so well. The Cameo DC-500 subsystem employs a decade-proven **cartridge** disk. Our backup capability is built in, and takes four minutes. The ability to switch applications (by exchanging the removable cartridge) means you can use your computer for more kinds of work. A ten megabyte (5 fixed + 5 removable) subsystem costs $5995, for your **TRS-80* (Mod. I or II), Apple*, Heath H89**T.M. **or S-100** computer.

So call **us** "The **Cartridge Disk** Guys", please, and call us soon. We'll show you the **really** cost-effective solution to microcomputer database storage.



* TRS-80 is a registered trademark of the Tandy Corp. *Apple is a registered trademark of Apple Corp.

Circle 148 on inquiry card.

Piagetian learning (after the Swiss philosopher-scientist Jean Piaget who has done more than anyone else to show us how very much children learn in this way).

Much of the work done to date in the whole area of computers and education—eg: CAI—has promoted a style of learning that gives the impression of a child being "programmed" by the computer. Our approach has been diametrically opposed to that. By striving to make the computer's processes as transparent as possible and creating activities in which children "teach" (ie: program) computers in a well-structured, procedural language like LOGO, we have aimed toward putting children in control of their own learning. Obviously, I cannot hope to explore these ideas in much depth in a short space. What I shall try to do is to describe a couple of learning environments we have created which I believe challenge the fundamental assumptions our society makes about children and learning.

Mathland

The belief that only a few people are mathematically minded is a truism in our culture and a cornerstone of our educational system. It is therefore sobering to reflect on the flimsiness of our reasons for believing it. In fact, the only evidence is crass empiricism: look around and you will see that most people are very poor at mathematics. But look around and see how poor most Americans are at speaking French. Does anyone draw the conclusion that most Americans are "not French-minded?", that they are not capable of learning French? Of course not! We all know that these same people would have learned to speak French perfectly well had they grown up in France. If there is any question of lack of aptitude, the aptitude they lack is not for French as such but for learning French in schools.

Could the same be true of mathematics? Could there be a place, a "mathland," which is to mathematics as France is to French, where children would learn to speak mathematics as easily and as successfully as they learn to speak their native dialect?

I believe that the answer is *Yes*. In *Mindstorms* I suggest that the world we live in contains pockets of mathland, which explains why all children learn some mathematics spontaneously (eg: one-to-one correspondences, conservation of number, reversibility of logical operations) and some children become very good at it. Here I have space only to talk about some ways in which the world could become much more of a mathland for everyone.

Computers are the Proteus of machines: they take on many different forms. One of their manifestations is as mathematics-speaking beings. If children grew up surrounded by such beings, the learning of mathematics might very well be much like the learning of spoken language. Developing and testing this image has become a central research question for us at MIT: under what conditions will children talk in mathematical languages to mathematics-speaking computers? The results have already convinced us that the idea of mathland is fundamentally sound and that, indeed, what the mathematics schools fail to teach can be learned successfully on the model of picking up living languages.

But computers do not automatically create that result. For example, instructing computers in FORTRAN to

AN EASY SOLUTION to hard copy needs

What do you need?

Program listings . . . inventory listings . . . custom logos and letters . . . mailing labels in a multitude of sizes . . . custom forms and the data to complete them . . . curve plotting or bar graphs . . . digitized images from video or bit pads . . . multi-part forms . . . preprinted forms . . . tickets . . . and the list goes on . . .

How do we do it?

High speed bi-directional full logic printing; two standard character sets, upper/lower case with descenders; high speed font at 165 cps; letter quality font at 90 cps; expanded characters, solid underlining; programmable character sets; complete dot control graphics; adjustable tractor feed 3"-16"; user adjustable platen; programmable tabs, forms length and line spacing; out of paper signal; self-test; interface options — RS-232C, Centronics parallel, Apple, S-100; and the list goes on . . .

The Malibu Model 165

Find out if it's the easy solution to your hard copy needs — contact your local computer dealer or you can write or call us today for complete specifications and print samples — you won't be disappointed.

Versatility, Quality and Reliability: We build it in.



Dealers and OEM'S, call us about our new purchase programs with prices, terms and delivery to meet your needs too.

2301 Townsgate Road, Westlake Village, CA 91361 (805) 496-1990
a subsidiary of Datametrics Corporation

Circle 150 on inquiry card.

manage inventories is of no interest to the average child. Babies brought up in IBM computer centers will be no better at mathematics than any others. They may even be worse (and their other lapses of culture might be more disturbing). In order for computers to play the role of mathland for a child, two conditions are necessary: the computer must understand a language a child can learn (and love to learn), and the computer must be able to do something for the child.

Euclidean Geometry → Cartesian Geometry → Computational Geometry

Turtle graphics is this kind of mathland. It was first developed in our laboratory as part of the programming language LOGO and then taken over by several other languages including Smalltalk and UCSD-Apple Pascal.

A lot of experience has taught us that computer graphics can be a great turn-on. People of all ages enjoy putting images on the screen, and when these images can be made to move and change color, they acquire a dimension completely lacking in conventional pencil-and-paper drawing. At the heart of the work on turtle graphics is the idea of developing a new kind of geometry—"turtle geometry"—which provides powerful and yet easily accessible means to manipulate shapes and motions. To put this in perspective, recall that you probably encountered at school at least two styles of doing geometry: Euclid's style (primarily logical in structure) and Descartes' style (primarily algebraic). Turtle geometry is a new style matched to the computer: it is a computational style of thinking about geometry. The difference in spirit is illustrated by how one thinks about a familiar geometric object in Cartesian and in turtle geometry. Descartes taught us to think of the circle as an equation such as:

$$x^2 + y^2 = R^2$$

In turtle geometry it is possible to use such equations, but the natural way to think about a circle is as a process. To do this, turtle geometry adopts as its fundamental concept an entity called a *turtle* whose properties include its *position* (as does the point in Euclidean and Cartesian geometry) and also its *heading*. At any particular time, it is at a position and is facing in a particular heading. The position and the heading are changed by commands that are built into a programming language. Among these are FORWARD <*some number*> which causes the turtle to move in the direction of its heading without changing the heading, and RIGHT <*some number*> which causes the turtle to change the heading while keeping the position fixed; ie: to pivot in place. Given these commands, a program in LOGO to draw a square of a certain fixed size takes the simple form:

```
TO SQUARE
FORWARD 100
RIGHT 90
FORWARD 100... etc
```


INFLATION FIGHTER—ROUND # 2

KO Inflation With Our Knock-Out Prices

SAVE $150!

$599

Reg. List $749

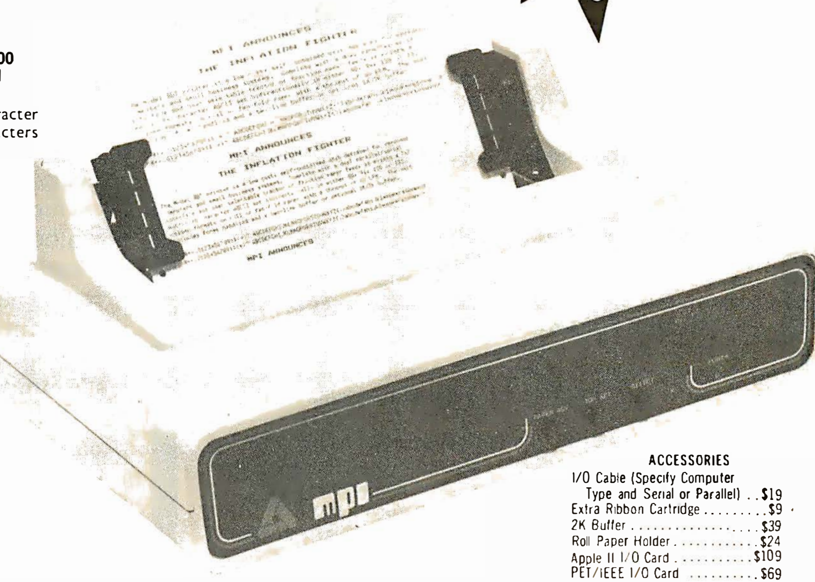
MPI 88T Impact Matrix Printer

Quality, Full-Page 8½x11 Printout For Your Computer

• APPLE II • TRS 80 • PET • ATARI
• SUPERBRAIN • EXIDY • OHIO SCIENTIFIC

Unrivaled champion of the small business, educational, personal computing and professional user. Quality construction and continuous duty print head allow heavy usage. Attractive styling complements the most elegant of systems without sacrificing compact size.

• Type of Printing: **Impact bidirectional 7x7 dot matrix** • Print Rate: **100 characters per second** (maximum) • Thruput: 80 characters per second (maximum) • Character Set: Full **upper and lower case 96 character ASCII set,** software selectable single or double wide character fonts • Character Height: 0.10 in. (0.25 cm) • Print Format: 8.0 in. (20.3 cm) line length, **80** characters per line at 10 CPI, **96** characters per line at 12 CPI, **120** characters per line at 16.5 CPI, **132** characters per line at 16.5 CPI • Paper Feed: 10 lines per second, stepper motor controlled. User selectable pressure roller or tractor feed • Line Spacing: **6 or 8 lines per inch,** user selectable • Media: **Roll paper:** 8.5 in. (21.6 cm) wide by 5 in. (12.7 cm) diameter single ply or pressure sensitive multiple copy paper, 0.012 in. (3 mm) maximum thickness. **Fan Fold paper:** 1 in. (10.1 cm) to 9.5 in. (24.1 cm) sprocket (including sprocket margins), 0.012 inc. (3 mm) maximum thickness. **Cut Sheet paper:** Maximum width, 9.5 in. (24.1 cm) • Ribbon: Continuous loop cartridge, 20 yds. 0.5 in. (1.27 cm) wide black ribbon, 5 million character line • Input Power: 115/230 VAC. ± 10%, 50/60 HZ • Data Input: **Parallel:** Centronics compatible 7-bit ASCII, TTL levels with strobe, acknowledge returned to indicate data was received. **Serial:** RS232C or 20 ma Current Loop with BUSY (RS232C only) handshake, 10 or 11 bits: 100, 150, 300, 600, 1200 baud • **Data Buffer: 1K (2K optional)** • **Forms Control:** Top of Form (eight selectable forms lengths) Skip over perforation • Physical Dimensions: 16.25 in. (41.3 cm) wide x 10.75 in. (27.3 cm) deep x 6.25 in. (15.9 cm) high. Dimensions exclude paper and paper holder. Weight: less than 15 lbs. (6.75 Kg)



ACCESSORIES

- I/O Cable (Specify Computer Type and Serial or Parallel) . . $19
- Extra Ribbon Cartridge $9
- 2K Buffer $39
- Roll Paper Holder $24
- Apple II I/O Card $109
- PET/IEEE I/O Card $69

Other Contenders . . .

PRINTERS

- NEC 5510 RO w/tractor List $2950 . . . . $2595
- NEC 5520 KSR w/tractor List $3270 . . . . . . $2950
- Diablo 1650 RO w/tractor List $3425 . . . . . $2890
- Diablo 1650 KSR w/tractor List $3895 . . . . $3285
- TI 810 Basic Serial List $1895 . . . . $1645
- TI 810 Basic Parallel List $1940 . . . . $1695
- TI 743 KSR u/c ASCII List $1395 . . . . $895
- Anadex DP9500 200 cps List $1650 . . . . . . $1449
- Centronics 702 RO 120 cps List $2440 . . . $1995
- Centronics 703 RO 120 cps List $3140 . . . $2395
- Centronics 704 RO 180 cps List $2350 . . . $1885
- Sanders Media 12/7 50-200 cps List $4100 $3265

SUPER VALUE

ANACOM 150 List $1395 **NOW $1195**
(equivalent to TI810)

• 150 cps, bidirectional Logic Seeking • 80, 132 or 136 columns • 6 or 8 lines per inch • 5.5 ips slew speed • 9x9 Matrix upper and lower case with decenders • 10 char/inch • 5" to 14 7/8" fan fold paper, tractor feed • original plus 5 copies • 6 million character life snap-in ribbon cartridge • 120/240 VAC 50/60HZ power • Size 23" x 14" x 8" (58.4 cm x 35.6 cm x 20.3 cm metric) weight 30 lbs., (38 lbs. shipping)

S100 BOARDS

- Xitan ZPU (Z80) $149
  - SMB-2 I/O $349
  - Z-16K Static $219
  - D-16K Dynamic $179
  - D-32K Dynamic $329
- CCP 2032 32K Static List $710 . . . . $595
- CCP 2064 64K Dynamic List $700 . . . . $595
- CCP 2422 FD Controller List $400 . . . . $349

VIDEO DISPLAYS

- ADDS 25 List $1095 . . . . $895
- ADDS 40 List $1400 . . . . $1,245
- TELEVIDEO 912C List $925 . . . . $775
- TELEVIDEO 920C List $995 . . . . $895
- Hazetine 1500 List $1225 . . . . $995
- Hazetine 1420 List $995 . . . . $895
- Hazetine 1410 List $900 . . . . $795
- Microterm Mime I List $895 . . . . $795
- Microterm Mime II List $945 . . . . $845
- Soroc IQ 120 List $995 . . . . $795
- Soroc IQ 140 List $1495 . . . . $1295

MONITORS

- Leedex Video 100 List $199 . . . . $139
- Sanyo 9" List $199 . . . . $169
- Sanyo 15" List $299 . . . . $259

MODEMS

- UDS 103LP 300 Baud List $195 . . . . $169
- UDS 202 LP 1200 Baud List $295 . . . . $259
- Novation Cat 300 Baud Acoustic List $200 . . $169
- DC Hayes Micromodem for Apple List $379 . $339
- DC Hayes 80-103 List $299 . . . . $239

SOFTWARE

- CBasic-2 Disk Extended Basic $89
- MICROSOFT Basic-80 . . . . $289
  - Basic Compiler $325
  - Fortran-80 . . . . $399
  - Cobol-80 . . . . $599
- MICROPRO Super-Sort I $219
  - Super-Sort II $169
  - Super-Sort III $120
  - Word-Star $395
  - Word-Star/Mail-Merge $525
  - Word-Master $125
  - Data-Star $279

SPELL BINDER
The Super CP/M based word processing software!
ONLY $379

- Structured Systems . . . . Call for Price
- Peachtree . . . . Call for Price
- Graham Dorian . . . . Call for Price

All packages available in 8" CP/M and 5 1/4" CP/M for North Star, Micropolis, Vector Graphic, SuperBrain and others.

XITAN	Cassette	Disk
ZAPPLE Monitor	$25	
8K Basic	$50	
Super Basic	$95	$99
Disk Basic		$159
ZAPPLE Text Editor	$35	
Z-Tel Text Editor	$50	$69
Text Output Processor	$50	
Macro Assembler	$50	$69
Z-BUG		$89
Micro Z-BUG		$69
LINKER		$69
Fortran IV		$249

APPLE COMPUTER & ACCESSORIES

- Apple II 16K or Apple II+ $969
  - 16K Memory Add-On (for TRS-80, Exidy also) $69
  - Corvus 10 Megabyte Disk Drive $4650
  - Pascal Language System $445
  - Graphics Input Tablet $675
  - Disk II with Controller Card $495
  - Disk II without controller $440
  - Apple Soft II Firmware Card $155
  - Integer Firmware Card $155
  - Parallel Interface Card $155
  - Serial Interface Card $160
  - Communications Card $190
  - Sup-R-Mod FR TV Modulator $25
  - Sup-R-Term 80 col. Card $349
  - Dan Paymar Lower Case Kit $45
  - SVA 8" Disk Controller Card $349
  - CCS Arithmetic Processor Card $349
  - Clock/Calendar Card $239
  - Super Talker Speech Synthisizer $259
  - Romplus Card w/Keybd. Fltr $179
  - ALF Music Synthisizer $245
  - Parallel Interface No. 7720A $109
  - CCS GPID IEEE Interface $269
  - Microsoft Z-80 Soft Card w/CP/M $349
  - ROMWRITER $159
  - CCS Programmable Timer Module $159
  - Centronics Printer Int. Card $190
  - Silentype Printer w/INT. Card $529

APPLE SOFTWARE

- Pascal Language System $445
- Fortran Language Package $175
- The Controller Gen. Bus. System $529
- The Cashier Retail Mgt. & Inv. $209
- Applepost Mailing List System $45
- Applewriter Word Processor $69
- Visi-Calc $125
- Dow Jones Portfolio Evaluator $45
- Sub-Logic FS 1 Flight Simulator $23
- Applepost Graph & Plot System $85
- Desktop/Plan by Desktop Computers $85

PRINT ELEMENTS (3 Minimum)

- NEC Thimbles . . . . $13.50 ea.
- Plastic Daisy Wheels . . . . $8.50 ea.
- Metal Daisy Wheels . . . . $39.50 ea.

RIBBONS (12 Minimum)

- NEC Fabric . . . . $4.50 ea.
- NEC Multi-Strike . . . . $4.50 ea.
- Diablo Fabric . . . . $4.25 ea.
- Diablo Multi-Strike . . . . $4.95 ea.
- Qume Fabric . . . . $4.25 ea.
- Qume Multi-Strike . . . . $4.95 ea.

S100 MAINFRAMES
*(incl. power supply & mother board)

- Xitan 8 Slot* List $359 . . . . $239
- Calif Comp 12Slot* List $400 . . . . $359
- NNC 100 19Slot* List $610 . . . . $540
- NNC 80 8Slot* List $825 . . . . $729
  Space For 2 Vertical 8" Floppy Drives
- NNC 80 with drives List $2020 . . . . $1819
  (Shugart 801R)
- NNC 90 Dual 8" F.D. List $295 . . . . $249
- NNC 90 with drives List $1495 . . . . $1339
  (Shugart 801R)

S100 COMPUTERS

- NNC System 80 List $3995 . . . . $3695
  Dual 801R Drives, Z80, 2 Serial Ports
  2 Parallel Ports, 32K Static,
  DDFD Controller, CP/M
  - WITH 64K Dynamic Memory List $4195 . . . $3850
  - WITH 64K Static Memory List $4797 . . . . . $4395

DISK DRIVES

- Shugart SA400 5 1/4" $295
- Shugart 801R 8" $475

TERMS: Cash, check or money order, bank wire transfer, C.O.D. or credit cards. $10.00 minimum. Charge orders must include expiration date. Purchase orders also accepted from recognized institutions. Include telephone number with all orders. Advertised prices are for prepaid orders. F.O.B. shipping point. Charge and credit orders add 2%. CODs required 25% deposit. California residents add 6% sales tax. For shipping in U.S. add ($2.50 min.) 2% West U.S., 3% East of Mississippi, otherwise freight collect (air service where applicable). Foreign orders must be accompanied by payment in U.S. funds and include 10% for shipping. Quantities may be limited. Retail prices vary from mail order. All prices subject to change and all offers subject to withdrawal without notice. All equipment is new with manufacturers warranty unless otherwise indicated.

PALOMAR COMPUTER PRODUCTS

Call or Write For Free Catalog
(714) 744-7314/744-9595

910 W. San Marcos Blvd. # 105, San Marcos, California 92069

Circle 152 on inquiry card.

A slightly more sophisticated program to draw squares of varying size takes the form:

```
TO SQUARE SIZE
REPEAT 4 [FORWARD :SIZE RIGHT 90]
```

Now we can think of a circle as generated by:

```
TO CIRCLE
REPEAT 360 [FORWARD 1 RIGHT 1]
```

More sophisticated programming leads to circles of variable diameter and even to letting the number of steps go to the limit, but the simple example will illustrate the main point I want to make here. Children can solve the problem of drawing a circle by using a very powerful heuristic principle: play turtle, walk out yourself what you want the turtle to do and describe what you did in turtle language. The children are practicing a lot of powerful ideas. They are exposed to the idea of using heuristic knowledge, they are learning to think of formal mathematics as rooted in (not opposed to) intuitive body-mathematics, and they are using mathematics as a language; moreover, they are learning to think about mathematics not as a ritual to be learned by rote but as an instrument to be used for personal ends.

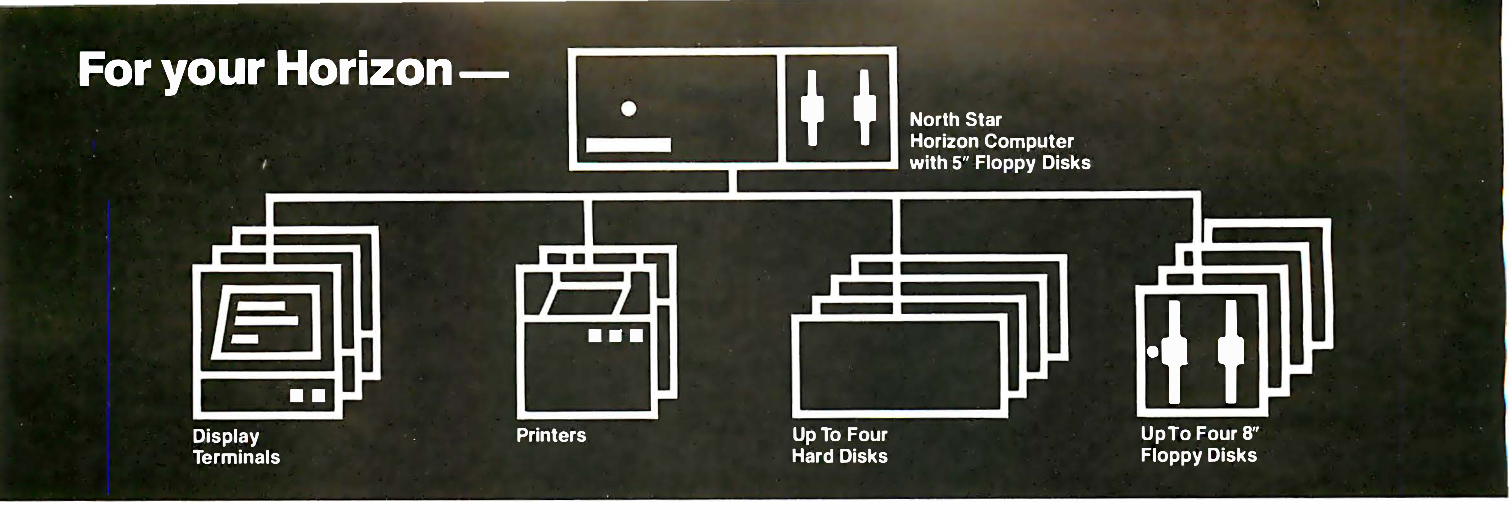
Computer as Pencil

This image refers to the many uses of the pencil: it is used to scribble, to doodle, to draw, to write, to work sums, or to chew on. It is used for illicit notes as well as for official assignments. I see the computer in the life of the child as equally ubiquitous and equally versatile. I also see it as equally personal. Children own pencils, they are not intimidated by them. This should be equally true of the child's personal computer.

The metaphor of the pencil is a good way to summarize some of the ways the image of the computer I am building up here differs from the one that is becoming established in schools.

Suppose that the only access children had to pencils (which I take in a generic sense including pens, crayons, and the like) was at school, and even there "pencil time" had to be scheduled on the one or two pencils available to each classroom. This might (or might not) be better than having no pencils at all, but clearly under those conditions the pencil would not play the important role it now does in the intellectual development of children from infancy onwards. In my vision the computer will become as free a resource as the pencil now is.

Second, there is the question of the power of the computer to be used flexibly for many purposes. The microcomputers in schools today can barely be used flexibly by those few who have the inclination to become virtuoso programmers in BASIC. This is very different from the model of the pencil that can be picked up by everyone —even the one-year-old infant—and also used by the most sophisticated writer or artist. LOGO and Smalltalk are only first steps toward programming languages that will truly satisfy our slogan: "No threshold and no ceiling." A child of five or less should be able to write a program in the first few minutes of contact with the computer and a computer scientist should find the system congenial and rich.



More power, work, flexibility!

JOEDOS™
Jointly Operate Everything Disk Operating System

Switch from North Star BASIC to CP/M™ and back again with a simple command. Floating point and standard 8, 10, 12, and 14 digit precisions of North Star BASIC, as well as Digital Research's CP/M all on the same hard disk unit.

Designed to operate with the DISCUS M26™ 26.5 megabyte (formatted) Winchester-technology hard disk unit and North Star's Micro Disk System, JOEDOS brings you large mainframe performance at microcomputer cost and reliability. CP/M disk activity is amazingly quick through JOEDOS; access to North Star BASIC programs and files is unbelievable!

Speed and enormous storage capacity (as much as 106 megabytes) are only the beginning. Through JOEDOS, each hard disk unit may appear to be one drive or many different "drives" (as many as 147 double density 180K North Star 5¼" drive-size segments). As many as seven of these segmented "drives" may be addressed at any particular time. Segment size, file size and directory size are variable according to user's requirements. Maximum file size is 16 megabytes, while the maximum directory size for each segment is 8,160 entries.

JOEDOS — Micro Mike's hard disk operating system. Requires DISCUS M26 hard disk unit and controller and North Star Micro Disk System for operation. Includes CP/M.

JOEDOS $495

JOESHARE™
North Star Horizon™/DISCUS Hard Disk Timesharing System

Micro Mike's popular interrupt-driven, bank switching timesharing for North Star Horizon computer is now available with all the features of JOEDOS hard disk operating system. JOESHARE allows multiple users to access as many as four 26.5 megabyte hard disk units, simultaneously operating programs in North Star Basic or through CP/M.

JOESHARE — Micro Mike's North Star Horizon timesharing/DISCUS hard disk operating system. Requires North Star Horizon and DISCUS M26 hard disk unit for operation. Includes CP/M.

JOESHARE and manual $995

HDSHARE™
North Star Horizon/North Star Hard Disk Timesharing System

Soon to be available, a version of JOESHARE with all of the features of JOEDOS using the North Star hard disk. HDSHARE allows multiple users to access as many as four 18 megabyte North Star hard disk units, simultaneously operating programs in North Star BASIC or through CP/M.

HDSHARE — Micro Mike's North Star Horizon timesharing/North Star hard disk operating system. Requires North Star Horizon and North Star hard disk system for operation. Includes CP/M.

HDSHARE and manual $995

5.2SHARE™
North Star Horizon/Floppy Disk Timesharing System

Micro Mike's floppy disk timesharing system has some new enhancements. 5.2SHARE now supports 8, 10, 12, and 14 digit floating point and standard North Star BASIC with as many as four DISCUS 8" drives, operating in conjunction with the Horizon's 5¼" drives to provide in excess of 5 megabytes of external storage.

5.2SHARE — Micro Mike's interrupt-driven, bank switching timesharing for the North Star Horizon computer. Includes 8" drive software interface. For double density or quad capacity systems only.

5.2SHARE and manual $395

DOSCHG — Micro Mike's 8" drive interface to North Star DOS and BASIC. Requires North Star Micro Disk System and DISCUS 8" drives and controller for operation.

DOSCHG and manual $150

Program operation manuals are available for preview before software purchase.

Program Operation Manuals for each program $25

Programs are available in double density/quad capacity format only. Prices are subject to change without notice.

Contact your North Star dealer or Micro Mike's

MMike's
Micro Mike's, Inc.
905 South Buchanan Amarillo, Texas 79101 USA Telephone: 806/372-3633
making technology uncomplicated . . . for People

Third, I mention the use of the pencil and of the computer as writing instruments. The computer is rapidly becoming the standard writing instrument. Most journalists use word processors, as do increasingly many offices. I am using one as I compose this article. But the schools are not offering children this facility, although one could argue that it is children who are in most need of writing aids. The reason is clearly linked to the ratio of computers to students. One or two computers per class simply does not give enough access for the computer to become the primary writing instrument. On the other hand, one computer per child, which is how I think we should be thinking about the future, could lead to massive changes in the way children develop writing skills. A well-designed text editor makes editing—substitution and deletion of words, shifting of sentences or paragraphs, and so on—an easy and aesthetically acceptable process. Compare the situation of a child attempting such a task with paper and pencil: the mess of multiple erasures and labor of rewriting means that the first draft is almost always the final copy. I have seen children who hated writing become avid writers when they have a text editor at their disposal. Wide availability of computers with text-editing capabilities might lead to even more fundamental changes in children's relation to alphabetic representation of language. Consider the implications of the following story:

> *Recently I observed the first group of nursery-school children working with a computer called the Lamplighter Computer (a Texas Instruments 99/4 personal computer with additional memory to support an extended version of LOGO and a real-time text-editing system) developed over the past few years through a collaboration between our research group at MIT and Texas Instruments. A four-year-old girl (I shall call her Robin) was working with some dynamic graphics programs that allowed her to make shapes appear on the screen, move, change color, and stick together by pushing one or another of some fourteen keys on the keyboard. The plan was that when Robin was tired of using a program she would ask the teacher to set up a new program. And this is in fact what she did for the first few times. But then Robin took charge of the whole process and began typing the control characters necessary to interrupt a program she no longer wanted and typing the names of the programs she did want, even though this was at a measured rate of about two characters per minute. In breaking out of the role of dependence on adults, Robin symbolized the fact that computers will enable children to break out of many of the roles into which technological primitivity and social custom have cast them.*

We should not pass too quickly over the significance of the simple fact that Robin could make things happen by typing words. It might well be the first time in her life that alphabetic language actually served a real and personal purpose. The spoken language and its precursors enter from the first year of life into a significant process of interaction with the world. Learning to speak empowers the child. But for most children the act of writing serves at most to gain the approval of adults. Could this be the reason children learn to talk so easily and so young

while they learn to write with so much difficulty so many years later? Watching Robin left me more firmly convinced than ever of a conjecture I have pursued for quite a few years. Children could learn to write as early and as easily as they learn to speak if the environment in which they lived gave as much support to the alphabetic language as ours does to the spoken language. I have no doubt that if Robin had her own computer and could use it whenever she wished, and if this computer gave her access to enough exciting things to do, she would within weeks have mastered the keyboard, the alphabet, and enough of spelling and syntax to put her firmly on the road to the kind of mastery of written language that usually comes, if at all, well into the school years.

Meaning Versus Ritual in Learning

The fundamental question for education is not how to improve schools but how to understand why schools are necessary. Why is some knowledge (like learning to talk) picked up so easily and naturally from the culture, while other kinds of knowledge seem to require deliberate, organized instruction? In *Mindstorms* I explore the many factors that make a difference. Here I have space only for one. Children learn to speak because it is a *meaningful* activity, a meaningful part of their lives. It is not surprising that children do not learn to write when writing serves no real purpose in their lives. I think the computer can change this. For Robin, alphabetic communication was beginning to become purposeful. As computers become increasingly available to children I would expect many children to share Robin's experience of writing as a meaningful activity. This shift—from meaningless ritual imposed from above to purposeful, self-directed activity—is also true of Mathland. No activity in school is experienced as more devoid of meaning than the parody of mathematics known as school math.

The harm done by making children learn ritualistically goes very deep. It develops the worst possible habits of learning. It undermines the individual's self-confidence as an independent intellectual agent: it infantilizes the child. A shift to more meaningful learning of fundamental subjects could have far deeper consequences than improved mastery of these subjects. It could mean that children become more effective learners with greater intellectual self-respect. And if this happens, not only the nature of children's learning but also the role of children in society may have changed.

I have hinted at a vision of profound, even revolutionary, change in how children learn. I think this might happen. We have the technology to make it possible. But there is nothing inevitable about it. Society has a very bad track record in making intelligent use of new technologies, and, in this case, many vested interests are threatened by the changes I envision. The "system" will react by defending its old ways. Already in schools we see computers being used to reinforce instead of displace the most ritualistic teaching methods. I believe that the most profound effects of computers on how children learn could occur outside of schools. In fact, I think that computers would tend to make schools as we know them obsolete. But most of my "official research" is concerned with how to use computers in schools. Research funds are easily available for the reformist goals of improving schools. I believe that the most profound effects of computers could be to develop a new respect for children as independent intellectual agents. But most people in our country like to think of children as intellectually dependent.

How will it all work out? It is futile for me to play prophet, but worthwhile to bear some ideas in mind when thinking about the future. I want to end by mentioning an idea that encouraged me to think positively. I can best introduce it by comparing the education market with markets for other products. Suppose you invent a new kind of kitchen machine. If you can prove that there is a market of a million people, you will easily find the capital to develop the idea and get it out into the world. But if you invent a new approach to learning mathematics, the fact that a million people want it may be of no avail—a million people across the nation may still be a tiny minority with no clout in every school district. But once there are a few million owners of home computers capable of carrying powerful learning methods, you will have access to a market of individuals ready to spend personal dollars for the good of their children. The importance of this fact is not that it will enable good ideas now collecting dust on shelves to get out into the world. It will encourage inventive and ambitious people to enter the field of educational innovation in unprecedented numbers. It will be part of the creation of a new class of professionals and of entrepreneurs and perhaps even of "stars" analogous to what happened in the course of the emergence of cinema as a culture. The history of cinema has been the history of that culture. The future of computers in education will be indissociable from the story of the people who will make the computer culture. ■

References

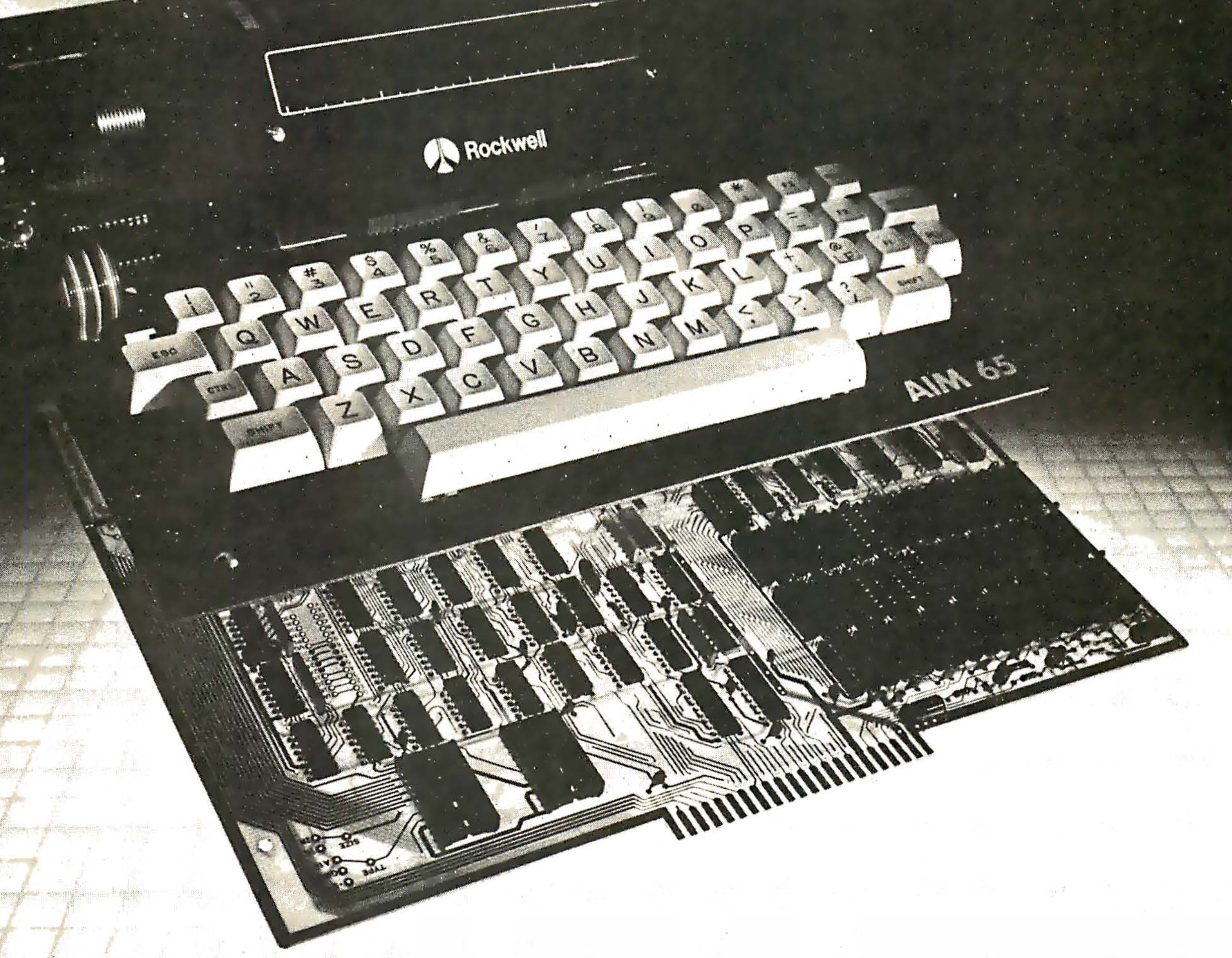
For more about Turtle Geometry see S Papert, *Mindstorms: Children, Computers and Powerful Ideas*. New York, Basic Books, 1980 (ISBN 0-465-04627-4, $12.95). Also see H Abelson and A diSessa, *Turtle Geometry*, MIT Press, Cambridge MA (to appear 1981). For a bibliography of the LOGO group's internal publications, write to LOGO, c/o MIT Artificial Intelligence Laboratory, 545 Technology Sq, Cambridge MA 02139. (Please include $1 for handling.)

Editor's note: *A note in the introduction to the July 1980 BYTE editorial incorrectly states that Education Forum articles by Seymour Papert and James Garson were to appear in the August and September BYTEs, respectively. However, because of unavoidable scheduling considerations, Seymour Papert's article is appearing this month, and James Garson's article will appear in a future issue. We apologize for any inconvenience this change might have caused....* **CM**

Education Forum *is an occasional feature in BYTE intended to foster debate about the uses of personal computers in the schools and colleges. We encourage reader participation. Contributors should supply their full names and addresses for publication, along with their telephone numbers, which will not be published.*

Circle 166 on inquiry card. →

Finally...Serious Expansion for the AIM-65



Introducing **Memory-Mate***, the AIM-65 expansion board that lets you spend your time on application solutions, not hardware hassles. Add Memory-Mate to your AIM-65 and make quick work of development and process control projects.

In its primary function, the Memory-Mate board provides 16-48K of RAM expansion assignable in 4K blocks anywhere in the system. Memory-Mate's parity check circuitry insures system RAM integrity (including AIM's 4K on-board RAM) for high reliability applications. The programmable write protect feature eases software development chores. This compact board, which fits directly **beneath** the AIM, also includes four programmable I/O ports, a tone generator for audible warnings, and sockets for 4K of PROM.

I/O intensive applications are accommodated with Memory-Mate's STD BUS interface option. Use off-the-shelf STD BUS cards to solve your biggest I/O problems.

The Memory-Mate with 16K RAM is priced at $475, with 16K expansion chip sets (including parity chip) costing $100 each. With 48-hour active burn-in and warranty for a full year, you won't have to worry about reliability either.

First of the complete AIM-Mate* series, Memory-Mate will be joined shortly by the Video-Mate*, Floppy-Mate* and the AIM-Mate case. For further information on the entire AIM-Mate series, write 'Attn: AIM-Mate Series' at the address below.

*TM Forethought Products

Forethought Products

87070 Dukhobar Rd., Eugene, OR 97402
(503) 485-8575

Introductory Special for BYTE Readers
16K Memory-Mate Board for $399 thru Sept. 30! Call for details.

Khachiyan's Algorithm, Part 2:
Problems with the Algorithm

G C Berresford, A M Rockett, and J C Stevenson
Dept of Mathematics
C W Post Center, Long Island University
Greenvale NY 11548

Numbering of figures, tables, listings, and equations is continued from Part 1.

A paper published by the Soviet mathematician Leonid Khachiyan received widespread publicity in late 1979 as a revolutionary new solution to linear programming problems. In Part 1 last month, we discussed the details of Khachiyan's algorithm and its corresponding geometric interpretation. This month in Part 2, we will look at the practical problems in using the algorithm and will examine a BASIC program that uses the algorithm.

A Linear Programming Example

The Whiz-Golly Computer Board Company makes two kinds of video boards: the Ohwow and the Hohum. Each board is handmade by Jim and then tested by Jack. Each Ohwow board takes Jim two days to complete, while he can make one Hohum board each day. Jack can test an Ohwow board in one day, but he needs two days for each Hohum. Like most basement entrepreneurs, Jim and Jack have many other things to do with their time. Jim will not make boards for more than four days a week; Jack will test them for no more than three days a week. If the profit is two dollars for each Ohwow board and three dollars for each Hohum, how many of each should they make per week to obtain the greatest profit?

This is a linear programming problem. It consists of a quantity to be maximized, the *objective function*, which is subject to a list of linear inequalities called *constraints*. If we let x_1 denote the number of Ohwow boards made per week and x_2 the number of Hohums made per week, the problem then is to maximize $P = 2x_1 + 3x_2$, where P is the profit per week in dollars.

Since Jim cannot make a negative number of Hohums in a week, the first constraints we find are the nonnegativity conditions: $x_1 \geq 0$ and $x_2 \geq 0$. In addition, we have the constraints imposed by the number of days that Jim and Jack work per week: for Jim, we have that $2x_1 + x_2 \leq 4$; while, for Jack, we have that $x_1 + 2x_2 \leq 3$.

This problem may now be written in matrix form as:

$$\text{to maximize } P = [2 \ \ 3] \cdot \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} \qquad (7)$$

$$\text{subject to } \begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix} \cdot \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} \leq \begin{bmatrix} 4 \\ 3 \end{bmatrix}$$

$$\text{and } \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} \geq 0$$

Of course, we could have combined the two constraint equation sets into one but, as most practical problems naturally include a nonnegativity condition, we will write it separately for emphasis.

The Dual Problem

By a *standard maximum linear programming problem* we mean any problem of the form:

$$\begin{aligned} &\text{to maximize} && P = \mathbf{c}' \cdot \mathbf{x} \\ &\text{subject to} && \mathbf{A} \cdot \mathbf{x} \leq \mathbf{b} \\ &\text{and} && \mathbf{x} \geq 0 \end{aligned} \qquad (8)$$

where $\mathbf{A}$ is an m-by-n matrix, $\mathbf{b}$ is a column vector in $\mathbf{R}^m$, $\mathbf{c}$ is a column vector in $\mathbf{R}^n$, and $\mathbf{x}$ is a column vector in n unknowns.

Since Jim and Jack may wish to minimize their expenses, we will also encounter minimization problems. A standard minimum linear programming problem is any problem of the form:

$$\begin{aligned} &\text{to minimize} && C = \mathbf{b}' \cdot \mathbf{y} \\ &\text{subject to} && \mathbf{A}' \cdot \mathbf{y} \geq \mathbf{c} \\ &\text{and} && \mathbf{y} \geq 0 \end{aligned} \qquad (9)$$

where $\mathbf{A}$, $\mathbf{b}$, and $\mathbf{c}$ are as in (8) and $\mathbf{y}$ is a column vector in m unknowns.

The two problems given by (8) and (9) are called *dual problems*, and their solutions are closely connected. Suppose that $\mathbf{x}$ satisfies (8) and $\mathbf{y}$ satisfies (9). Then $\mathbf{c'x} \leq (\mathbf{A'y})'\mathbf{x} = \mathbf{y'Ax} \leq \mathbf{y'b} = \mathbf{b'y}$ and we see that $\mathbf{c'x} \leq \mathbf{b'y}$ for any $\mathbf{x}$ and $\mathbf{y}$ satisfying the respective constraint equations. Since we wish to maximize $\mathbf{c'x}$ and to minimize $\mathbf{b'y}$, it follows that any pair of solutions, say $\bar{\mathbf{x}}$ and $\bar{\mathbf{y}}$, must satisfy $\mathbf{c'}\bar{\mathbf{x}} = \mathbf{b'}\bar{\mathbf{y}}$ and conversely.

To solve the pair of linear programming problems (8) and (9), we need only solve the following system of equations:

$$\begin{aligned} \mathbf{c'x} &= \mathbf{b'y} \\ \mathbf{Ax} &\leq \mathbf{b} \\ \mathbf{A'y} &\geq \mathbf{c} \\ \mathbf{x} \geq \mathbf{0} &\text{ and } \mathbf{y} \geq \mathbf{0} \end{aligned} \qquad (10)$$

The equality $\mathbf{c'x} = \mathbf{b'y}$ is equivalent to the two inequalities $\mathbf{c'x} - \mathbf{b'y} \leq \mathbf{0}$ and $-\mathbf{c'x} + \mathbf{b'y} \leq \mathbf{0}$. The nonnegativity conditions $\mathbf{x} \geq \mathbf{0}$ and $\mathbf{y} \geq \mathbf{0}$ are equivalent to $-\mathbf{I}_n\mathbf{x} \leq \mathbf{0}$ and $-\mathbf{I}_m\mathbf{y} \leq \mathbf{0}$ where $\mathbf{I}_k$ denotes the k-by-k identity matrix. The condition $\mathbf{A'y} \geq \mathbf{c}$ is equivalent to $-\mathbf{A'y} \leq -\mathbf{c}$.

If we let $\mathbf{z}$ be the column vector in $n+m$ unknowns formed by adjoining $\mathbf{y}$ to the end of $\mathbf{x}$ (that is, $\mathbf{z'} = (x_1,\ldots,x_n,y_1,\ldots,y_m)$), we can rewrite our linear programming problems in one giant system of inequalities:

$$\begin{bmatrix} \mathbf{A} \\ -\mathbf{I}_n \\ \mathbf{0}_{(n,\,n)} \\ \mathbf{0}_{(m,\,n)} \\ \mathbf{c'} \\ -\mathbf{c'} \end{bmatrix} \begin{bmatrix} \mathbf{0}_{(m,\,m)} \\ \mathbf{0}_{(n,\,m)} \\ -\mathbf{A'} \\ -\mathbf{I}_m \\ -\mathbf{b'} \\ \mathbf{b'} \end{bmatrix} \mathbf{z} \leq \begin{bmatrix} \mathbf{b} \\ \mathbf{0}_{(n,\,1)} \\ -\mathbf{c} \\ \mathbf{0}_{(m,\,1)} \\ 0 \\ 0 \end{bmatrix} \qquad (11)$$

where $\mathbf{0}_{(j,\,k)}$ denotes a j-by-k matrix of zeros. If this system of inequalities is consistent, then the point that satisfies all the inequalities at once gives the solutions to both the maximum and the minimum problems.

For our problem (7) with Jim and Jack, we see that the system (11) becomes:

$$\begin{bmatrix} 2 & 1 & 0 & 0 \\ 1 & 2 & 0 & 0 \\ -1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & -2 & -1 \\ 0 & 0 & -1 & -2 \\ 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & -1 \\ 2 & 3 & -4 & -3 \\ -2 & -3 & 4 & 3 \end{bmatrix} \mathbf{z} \leq \begin{bmatrix} 4 \\ 3 \\ 0 \\ 0 \\ -2 \\ -3 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

The solution to this problem, as we will see later, is:

$$\mathbf{z} = (\,1\tfrac{2}{3},\ \tfrac{2}{3},\ \tfrac{1}{3},\ 1\tfrac{1}{3}\,)$$

a solution that can be derived from the above matrix by use of Khachiyan's algorithm.

Some General Implementation Problems

As we mentioned in our discussion of Khachiyan's paper his achievement of obtaining a polynomial-time algorithm is attained only by paying the price of requir-

ing an incredible level of precision in all the calculations. Moreover, his initial circle of radius 2^L can be replaced by a far smaller circle, as will be explained shortly. This does not matter to Khachiyan, since, at the initial stage of the algorithm, the precision problems are more important.

The main problem we have created for ourselves is in our transformation of dual linear programming problems into a system of linear inequalities. Our statement that $\mathbf{c}'\mathbf{x} = \mathbf{b}'\mathbf{y}$ is equivalent to the inequalities $\mathbf{c}'\mathbf{x} - \mathbf{b}'\mathbf{y} \leq 0$ and $-\mathbf{c}'\mathbf{x} + \mathbf{b}'\mathbf{y} \leq 0$, while true mathematically, is generally false from a computational viewpoint.

If we think of $\mathbf{c}'\mathbf{x} - \mathbf{b}'\mathbf{y} \leq 0$ and $-\mathbf{c}'\mathbf{x} + \mathbf{b}'\mathbf{y} \leq 0$ as "half-planes" in some n-dimensional Euclidean space (shown in figure 4 for $n = 2$), then it is true that they will intersect along a "line," where $\mathbf{c}'\mathbf{x} - \mathbf{b}'\mathbf{y} = 0$. Unfortunately, our computer calculations of the common points will be rounded off to a finite number of decimal places, and we should not be surprised if we cannot correctly calculate a point that has zero difference between our calculated values of $\mathbf{c}'\mathbf{x}$ and $\mathbf{b}'\mathbf{y}$.

Our solution to this difficulty is to choose a tolerance within which we will agree that our values for $\mathbf{c}'\mathbf{x}$ and $\mathbf{b}'\mathbf{y}$ are essentially the same. Let $\epsilon > 0$ be this tolerance. If we require that $\mathbf{c}'\mathbf{x} - \mathbf{b}'\mathbf{y} \leq \epsilon$ and $-\mathbf{c}'\mathbf{x} + \mathbf{b}'\mathbf{y} \leq \epsilon$ then we have formed a "tube" around the line $\mathbf{c}'\mathbf{x} - \mathbf{b}'\mathbf{y} = 0$ (shown for $n = 2$ in figure 5) with width ϵ in the direction perpendicular to $\mathbf{x}$. The actual tolerance thus created will depend on the slope of the relation $\mathbf{c}'\mathbf{x} - \mathbf{b}'\mathbf{y} = 0$ relative to the $\mathbf{x}$ subspace.

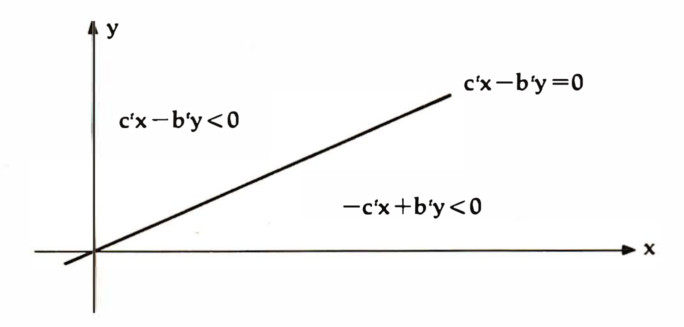


Figure 4: *Dissection of a plane into two half-planes by a line of the form* c'x−b'y=0.

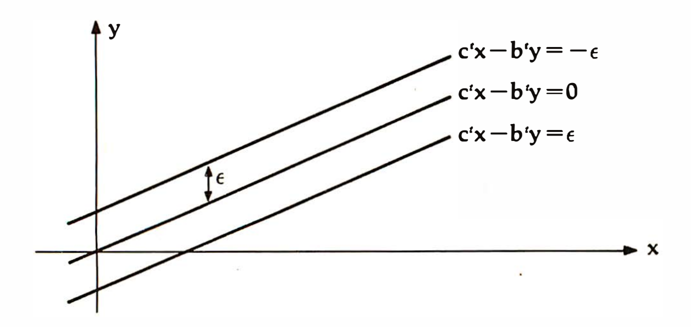


Figure 5: *Dissection of a plane into two half-planes dictated by the limited accuracy of a computer. Because any computer has a limited accuracy, it is unlikely for it to compute the exact location of a point on the line* c'x−b'y=0. *Instead, the line separating the two half-planes (as shown in figure 4) is replaced by a thin "tube" with a diameter less than or equal to 2ε. The variable ε is chosen so that a given computer can compute the location of a point that is no more than ε away from a point on the center line.*

Thus our system of inequalities is no longer (11) but rather:

$$\begin{bmatrix} \mathbf{A} & 0_{(m,\,m)} \\ -\mathbf{I}_n & 0_{(n,\,m)} \\ 0_{(n,\,n)} & -\mathbf{A}' \\ 0_{(m,\,n)} & -\mathbf{I}_m \\ \mathbf{c}' & -\mathbf{b}' \\ -\mathbf{c}' & \mathbf{b}' \end{bmatrix} \mathbf{z} \leq \begin{bmatrix} \mathbf{b} \\ 0_{(n,\,1)} \\ -\mathbf{c} \\ 0_{(m,\,1)} \\ \epsilon \\ \epsilon \end{bmatrix} \qquad (12)$$

Let us now turn to the problem of estimating an initial region that will contain all solutions of the system of linear inequalities (2), from Part 1. The solutions of the systems, if any exist, form a polyhedron determined by the vertices at which the linear inequalities intersect. We can take for our initial region any sphere about the origin containing all these vertices, since such a sphere must then include some solution points of the system.

The problem is then to estimate the distance to the vertex furthest from the origin. The system may be written as $\mathbf{A}\mathbf{x} \leq \mathbf{b}$ where $\mathbf{A}$ is an m-by-n matrix of integers and $\mathbf{b}$ is a column vector with m integer entries. We may suppose that $m \geq n$ since we can otherwise add on $n-m$ trivial inequalities that will not change the solutions of the original system and will add only 0s and 1s to the matrix $\mathbf{A}$.

We can now compute all possible vertices of the region $\mathbf{A}\mathbf{x} \leq \mathbf{b}$ by examining n rows of the equation $\mathbf{A}\mathbf{x} = \mathbf{b}$ at a time and applying Cramer's rule. For each subset of n equations, we will find $x_i = \frac{D_i}{D}$, for $i = 1,\ldots,n$, where D is the determinant of the n-by-n matrix of equation coefficients and D_i is the determinant of the same matrix, but with corresponding n entries of $\mathbf{b}$ replacing the ith column of the matrix.

Since we are dealing with integer coefficients, if $D \neq 0$, then $|x_i| \leq |D_i|$; and, by Hadamard's inequality, $|D_i|$ is no more than the product of the norms of the columns of the matrix in question. This now explains $\mathbf{Q}_0 = 2^L \cdot \mathbf{I}_n$, since 2^L is greater than the product of the absolute values of all the coefficients in the system (2). We now see that an estimate better than 2^L will result if we determine the greatest possible norm for the n-subsets of each column of $\mathbf{A}$ and then combine the $n-1$ greatest such norms with the greatest n-subset norm from $\mathbf{b}$. For example, Khachiyan's estimate for the region of (7) is 2^{44} while the above estimate based on Hadamard's inequality is 2^9.

The problems caused by the precision needed in computing the values required at each step of the algorithm appear to be nearly insurmountable. We shall not pursue this subject further than to observe its central position in the list of difficulties that prevent Khachiyan's algorithm from immediately replacing the Simplex method as the preferred method for solving linear programming problems.

Khachiyan's Algorithm on the TRS-80

The program given in listing 1 represents a translation of the preceding discussion into a computer program. In writing this program, we have attempted to make the translation as literal as possible for two reasons. First, we wished to study how Khachiyan's algorithm actually pro-

ceeds for real examples. Second, once the program is running, it remains a challenge for each user to discover improvements and modifications. We invite you to experiment.

The program will accept two different kinds of problems. If you wish to study the consistency of a system of linear inequalities such as equation set 2 (given in Part 1 of this article, last month), the program will accept the equations in the form **Ax** ≤ **b**. If you wish to study a linear programming problem such as (8) or (9), the program will ask for **A**, **b**, **c**, and ϵ. The program will then create the system given by (12). In either situation, you will have three choices for L: you may have Khachiyan's or Hadamard's values computed or you may specify your own choice.

Because of the limited precision available on the TRS-80 (far less than the 2^{-37nL} required for the algorithm), our program cannot be used to decide the consistency or inconsistency of even the smallest systems of inequalities. Thus it becomes meaningless to terminate the algorithm after $N = 16Ln^2$ steps, so our program does not include a termination statement based on the number of steps executed.

If you enter the system of inequalities (1.1), you can watch the algorithm construct a solution point. It will take about thirty-eight steps to begin to find a reasonable estimate for **x**. When you try equation set 1.2 (an inconsistent system given in Part 1), you will be able to watch the algorithm attempt to find a solution (a reasonable compromise between the inequalities is (1.5, 1.5)) and then decide that it had better try again.

The actual solution of the linear programming problem given in (7) and its dual is $(x_1,x_2) = (1\frac{2}{3},\frac{2}{3})$ and $(y_1,y_2) = (\frac{1}{3},1\frac{1}{3})$. You should try various values for ϵ and contrast the number of steps required for the algorithm to terminate at a solution.

Klee-Minty Example

As we noted earlier, the importance of Khachiyan's algorithm is that the number of steps required increases as a polynomial based on the size of the system of in-

Text continued on page 255

Listing 1: *A program using Khachiyan's algorithm, written for the Radio Shack TRS-80 Model I running Level II BASIC.*

```
1 '********************************************************
2 '*                  KHACHIYAN'S ALGORITHM                 *
3 '*COPYRIGHT 1979 JC STEVENSON, AM ROCKETT, GC BERRESFORD*
4 '********************************************************
5 CLEAR100
10 CLS
20 DATA 1,119,1,119,1,119,3,69,118,120,4,69,116,117,121,4,69,115,122,123,8,68,69
,70,95,114,123,124,125,8,67,71,95,112,113,125,126,127,11,64,65,66,72,73,74,94,96
,110,111,123,14,60,61,62,69,73,74,75,76,77,78,93,96,107,124,11,58,60,61,70,79,89
,91
30 DATA 98,99,105,124,10,57,71,72,80,81,87,95,100,101,102,10,56,73,77,81,82,85,9
6,103,104,125,11,56,73,77,78,81,82,85,97,100,103,104,10,56,72,77,81,82,86,97,102
,103,123,11,57,58,80,81,87,88,96,100,101,102,104,13,59,79,80,89,98,99,100,101,10
5,106,107,121,127
40 DATA 8,60,78,79,89,100,106,107,127,1,107
50 FOR I=0 TO 448 STEP 64 : PRINT@I,STRING$(64,191);:NEXT I
60 FOR I=448 TO 511 STEP 2 : PRINT@I,CHR$(131);CHR$(128);:NEXTI
70 PRINT@576,STRING$(4,128);TAB(51)STRING$(13,128);
80 PRINT@512, STRING$(64,128);
90 PRINT@651,"T H E  K H A C H I Y A N  A L G O R I T H M";
100 PRINT@843,"COPYRIGHT 1979";:PRINT@907,"J.C. STEVENSON, A.M. ROCKETT & G.C. B
ERRESFORD";
110 FOR I = 3 TO 20
120 READ JJ
130 FOR J=1 TO JJ : READ J2 : RESET(J2,I) : NEXT J
140 NEXT I
150 FOR I=1 TO 1000 : NEXT I
160 PRINT@834,"DO YOU WISH TO READ THE INTRODUCTION?";
170 PRINT@898,"TYPE 'Y' IF YOU DO, ELSE HIT 'ENTER' TO PRINT THE MENU.";
180 C$=INKEY$ : IF C$="" THEN 180
190 IF C$="Y" THEN 200ELSE 230
200 PRINT@768,"THIS PROGRAM HAS TWO OPTIONS.  YOU MAY USE IT TO SOLVE A LINEAR P
ROGRAMING PROBLEM OR YOU MAY VERIFY THAT A SYSTEM OF INEQUALI- TIES IS CONSISTEN
T.  IF YOU CHOOSE TO SOLVE A PROBLEM, THERE ARE THREE  OPTIONS  FOR CHOOSING THE
 PARAMETER, L.";
210 PRINT"  SEE KHACHIYAN'S PAPER FOR NOTATION.  PRESS 'ENTER' TO CONTINUE.";
220 Z$=INKEY$ : IF Z$="" THEN 220
230 CLS : PRINT@88,"T H E  M E N U " : PRINT @266,"1) SOLVE AN L-P PROBLEM.":PRI
NT@394,"2) CHECK CONSISTENCY OF A SYSTEM.":PRINT:PRINT:INPUT"ENTER THE NUMBER OF
 THE OPTION YOU WISH";C%
```

Listing 1 continued on page 248

Circle 159 on inquiry card.

Listing 1 continued:

```
240 '
250 DEFDBL A,B,F,X,V,W,Q,L
260 CLS
270 '*******  HOW TO USE THE PROGRAM  ********
280 INPUT"DO YOU WISH TO REVIEW THE FORMAT FOR ENTERING A PROBLEM (Y/N -- 'ENTER
')";Z$
290 IF Z$="N" THEN 400
295 IF C%=1 THEN 300 ELSE CLS:PRINT"TO DECIDE THE CONSISTANCY OF A SYSTEM OF INE
QUALITIES, WRITE THE SYSTEM IN  THE FORM:":PRINTTAB(23)"  A*X <= B":PRINT"WHERE
A IS A N BY N MATRIX AND B AN N-VECTOR.  PRESS 'ENTER' TO BEGIN."
296 Z$=INKEY$:IFZ$=""THEN 296 ELSE 400
300 CLS
310 PRINT"TO SOLVE A STANDARD LINEAR PROGRAMMING PROBLEM OR CHECK        CONSIS
TANCY:":PRINT:PRINT"1) WRITE THE PROBLEM IN THE FORM: MAXIMIZE (C,X)
                    SUBJECT TO THE CONSTRAINTS     A*X <= B"
320 PRINT"                                    AND       X => 0"
330 PRINT"   X AND C ARE COLUMN VECTORS OF DIMENSION N WHILE B               IS
AN M-VECTOR.  A IS AN M BY N MATRIX.  THE NOTA-                TION, (.... , ....)
 IS A STANDARD INNER PRODUCT."
340 PRINT:PRINT:PRINT:PRINT"HIT 'ENTER' TO CONTINUE THE DIRECTIONS"
350 Z$=INKEY$ : IF Z$="" THEN 350
370 CLS:PRINT:PRINT"2) THE COMPUTER SEEKS A SOLUTION OF THE EQUATION
         (C,X) = (B,Y) WHERE Y IS A SOLUTION OF THE DUAL.              IN GENERA
L THE MACHINE CANNOT ACHEIVE THIS, SO A                 TOLERANCE , EPSILON, MUST
 BE GIVEN"
380 PRINT:PRINT"3) PRESS 'ENTER' TO BEGIN THE ALGORITHM.  THE  COMPUTER WILL ASK
   YOU FOR EACH ITEM ABOVE."
390 Z$=INKEY$:IFZ$="" THEN390
400 CLS: INPUT"HOW MANY ROWS HAS THE MATRIX A"; M : INPUT"HOW MANY COLUMNS IN TH
E MATRIX A"; N
```

Listing 1 continued on page 250



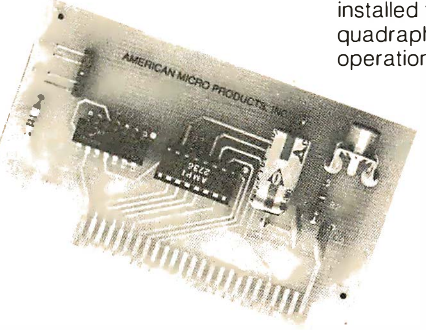
Listing 1 continued from page 248:

```
410 IF C%=2 THEN N9=N : M9 =M : GOTO 430
420 N9=M+N : M9=2*(M+N+1)
430 DIM A(N9,M9),B(M9),X1(N9),X0(N9),F(M9),Q1(N9,N9),Q0(N9,N9),V(N9,N9),W(N9,N9)
,B1(M9)
440 CLS: PRINT"PLEASE TYPE IN THE ROWS OF THE MATRIX  A.  PRESS 'ENTER' AFTER  K
EYING EACH NUMBER."
450 FOR J=1 TO M
460 FOR I=1 TO N : INPUT A(I,J) : NEXT I
470 NEXT J
480 CLS:PRINT"HERE IS THE MATRIX A.  IF IT IS NOT CORRECT, NOTE THE INDICES OF T
HE MISKEYED ELEMENTS.  PRESS 'C' TO MAKE CORRECTIONS, ELSE HIT 'ENTER'."
490 FOR J=1TOM : FOR I=1 TO N : PRINT A(I,J);"   ";:NEXTI:PRINT:NEXTJ
500 Z$=INKEY$ : IF Z$ ="" THEN 500
510 IF Z$="C" GOSUB 700ELSE 530
520 GOTO 480
530 CLS: PRINT"PLEASE TYPE IN THE ENTRIES OF THE VECTOR B, YOU NEED ";M;"NUMBERS
."
540 FOR I=1TOM : INPUT B(I) : NEXT I
550 CLS:PRINT"HERE IS THE VECTOR B." :FOR I=1 TO M : PRINT B(I) :NEXT I: INPUT"I
S IT CORRECT (Y/N)";Z$ : IF Z$="N" THEN 530
560 IF C%=2 THEN 730
570 CLS:PRINT"WHAT ARE THE COEFFICIENTS OF THE OBJECTIVE FUNCTION?  YOU MUST   S
UPPLY";N;"NUMBERS."
580 FOR I=M+1 TO N9 : INPUT B(I) : B(I) = -B(I) :NEXT I
590 CLS: PRINT"THE COEFFICIENTS OF THE OBJECTIVE FUNCTION ARE:"
600 FOR I = M+1 TO N9 : PRINT -B(I) : NEXT I
610 IF C%=2 THEN 730
620 INPUT"IS THE OBJECTIVE FUNCTION CORRECT (Y/N)";Z$ : IF Z$="N" THEN 590
630 CLS: INPUT"WHAT POSITIVE NUMBER DO YOU WANT FOR THE 'TOLERANCE', EPSILON
        ";B(M9-1) : B(M9)=B(M9-1)
640 FOR I=1 TO N : FOR J = 1 TO M : A(N+J,M+I)=-A(I,J) : NEXT J : NEXT I
650 FOR I=M+N+1 TO M9-2 : A(I-M-N,I)=-1 : NEXT I
660 FOR J=1 TO N : A(J,M9-1)=-B(J+M) : A(J,M9)=B(J+M) : NEXT J
670 FOR J=N+1 TO N9 : A(J,M9-1)=-B(J-N) : A(J,M9)=B(J-N) : NEXT J
680 GOTO 730
690 STOP
700 CLS: INPUT"TO CORRECT ENTRIES IN A, ENTER THE ROW AND COLUMN INDICES OF THE
ELEMENT TO BE CORRECTED";I,J: INPUT"NOW ENTER THE CORRECT VALUE";A(J,I)
710 INPUT"CORRECTIONS COMPLETE (Y/N)";Z$ : IF Z$="N" THEN 700
720 RETURN
730 CLS
740 PRINT"INDICATE YOUR CHOICE FOR THE DETERMINATION OF L FROM THE LIST   BELOW:
":PRINT:PRINT:PRINT"          1) KHACHIYAN'S FORMULA":PRINT:PRINT"          2) H
ADAMARD'S INEQUALITY":PRINT:PRINT"          3) YOUR OWN CHOICE.":INPUTIC%
750 ON IC% GOTO 770,2040,760
760  INPUT "WHAT IS YOUR VALUE FOR L";LL:GOTO780
770  LL=0 : FOR I=1 TO N9 : FOR J=1TO M9 : LL=LL+LOG(ABS(A(I,J))+1):NEXT J : NEX
T I : FOR I=1 TO M9: LL=LL+ LOG(ABS(B(I)) +1):NEXT I : LL= LL + LOG(N9*M9): LL=
INT(LL/LOG(2))+1
780 PRINT "THE VALUE OF L FOR THIS RUN IS: ";LL
790 INPUT"DO YOU WISH TO CHANGE L (Y/N)";Z$ : IF Z$="Y" THEN 730
800 FOR I=1 TO M9 : B1(I)=-B(I) : NEXT I
810 FOR I=1 TO N9
820 Q0(I,I) = 2 [ LL
830 NEXT I
840 GOSUB 1960: T0=MX
850 '    *****   END OF INITIALIZATION   ******
860 '
870 K7=0
880 '
890 '  ****  BEGINNING OF MAIN ITERATION  ****
900 '
910 K7=K7+1 : CLS : PRINT "COMPUTING STEP #";K7:PRINT"THE CURRENT DISCREPANCY IS
:";MX: FOR I=1 TO N9 : PRINT "X(";I;")=";X0(I) : NEXT I
```

Listing 1 continued on page 252

APPLE II® COMPATIBLE
MUSIC SYNTHESIZER

- Three simultaneous programmable voices and one programmable white noise generator
- Five octave range starting at 55 Hz (the A below bass clef) to 1760 Hz (the second A above the treble clef)
- On board amplifier capable of directly driving an eight ohm speaker
- Up to six synthesizers can be installed to create stereophonic, quadraphonic, and polyphonic operation.



$99.95

KIS MUSIC EDITOR







KIS stands for KEEP IT SIMPLE and we believe there is no existing software that remotely approaches the ease and convenience of this music editor. Some of the many features are as follows:

- Three part interactive program consisting of a play mode, a composition mode and an edit mode
- Plan mode displays low resolution color graphics of each voice while the song is playing
- Composition mode enables the user to hear and see, in high resolution graphics, each note as it is input
- Edit mode sounds and displays, in high resolution graphics, each note as the user single steps through the song. Notes can be inserted, deleted, and changed.

FREE
(See Below)

FLASH AND CRASH SOUND EFFECTS



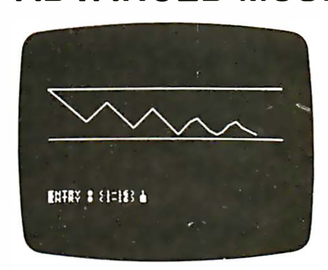
---- AMERICAN MICRO PRODUCTS INC. ----
SOUND SYNTHESIS
CHOOSE FROM THE FOLLOWING
(1) BIZARRE MUSIC#2
(2) CHIMES
(3) LUNAR ODYSSEY
(4) SIRENS
(5) JET
(6) CONTINOUS SOUND DEVELOPMENT
(7) RANDOM TONES
(8) PROGRAMMING INSTRUCTIONS
(9) SIREN 1
(*) ANY OTHER KEY FOR PAGE 3
YOUR SELECTION?

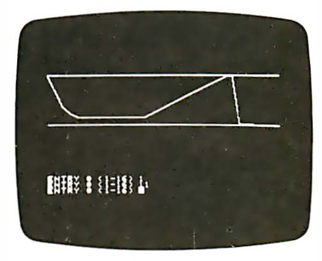


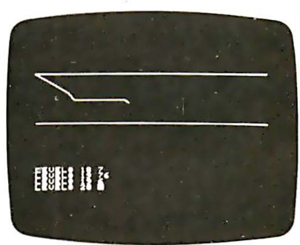
- Uses the channel of white noise to create a vast array of sounds. Some of these are as follows: explosions, steam engine, whistle, phasers, gun shot, race cars, sirens, chimes, and jet engines
- Detailed instructions illustrate how to generate sounds
- Modular so any one sound can easily be patched into an existing program.

$39.95

ADVANCED MUSIC EDITOR







- Sixteen standard envelopes provided
- Custom envelopes can easily and quickly be developed
- All envelopes (including user created) are depicted in high resolution graphics and each can also be heard.
- Tempo, attenuation, and envelope can be selected and changed as many times as needed during the playing of the song.
- Musical subroutines can be called.
- The channel of white noise is used to produce a drums, chimes and other percussion effects.

NOW INCLUDES:
KIS MUSIC EDITOR
ADVANCE MUSIC EDITOR
MUSIC SYNTHESIZER

$129.95

® Registered Trademark of Apple Computer



705 Bowser
Richardson, Texas 75080
(214) 238-1815

Distributed by:
Hayden Publishing

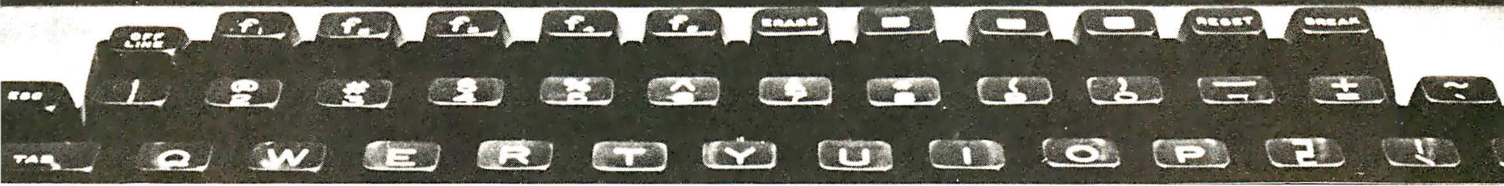
Circle 162 on inquiry card.

Listing 1 continued from page 250:

```
920 FOR I = 1 TO N9
930 F(I)=0
940      FOR J = 1 TO N9
950      F(I)=F(I)-Q0(J,I)*A(J,I0)
960      NEXT J
970 NEXT I
980 GOSUB 1010
985 GOTO 1090
990 '  **** FIND THE NORM OF F *****
1000 '
1010 NF=0
1020 FOR I=1 TO N9
1030      NF = NF + F(I)*F(I)
1040 NEXT I
1050 NF = SQR(NF)
1055 IF NF=0 PRINT"WARNING!!!!! THE NORM OF F IS ZERO.  IF YOU WISH TO CONTINUE,
 TYPE 'CONT' FOLLOWED BY 'ENTER'"
1060 RETURN
1070 '  **** STEP TO NEW X-ITERATE ****
1080 '
1090 FOR I=1 TO N9
1100 X1(I)=0
1110      FOR J= 1 TO N9
1120      X1(I)=X1(I)+Q0(I,J)*F(J)
1130      NEXT J
1135 IF NF=0 CLS:PRINT"THE NORM OF F IS TOO SMALL, PRODUCING A MACHINE ZERO.":PR
INT"HERE IS THE VECTOR F:":FOR I = 1 TO N9 : PRINT"F(";I;")=";F(I): NEXT I : PRI
NT"PROGRAM HAS BEEN STOPPED":STOP
1140 X1(I)=X0(I) + X1(I)/NF/(N9+1)
1150 NEXT I
1160 GOSUB 1590
1170 '
1180 '  **** STEP TO THE NEXT Q-ITERATE ****
1190 '
1200 FOR I = 1 TO N9
1210      FOR J = 1 TO N9
1220          Q1(I,J)=0
1230          FOR K= 1 TO N9
1240               Q1(I,J)= Q1(I,J)+ Q0(I,K)*V(K,J)
1250          NEXT K
1260      IF J=1 LET Q1(I,J)=Q1(I,J)*N9/(N9+1)
   ELSE LET Q1(I,J)=Q1(I,J)*N9/SQR(N9*N9-1)
1270      Q1(I,J)=Q1(I,J)*2[(1/(8*N9*N9))
1280      NEXT J
1290 X0(I)=X1(I)
1300 NEXT I
1310 FOR I= 1 TO N9
1320     FOR J = 1 TO N9
1330     Q0(I,J)=Q1(I,J)
1340     NEXT J
1350 NEXT I
1360 '
1370 '  ****  COMPUTE THE NEW DEFECT  ****
1380 '
1390 FOR I= 1 TO M9
1400    B1(I)=0
1410     FOR J = 1 TO N9
1420     B1(I)=B1(I) + A(J,I)*X0(J)
1430     NEXT J
1440 B1(I)= B1(I)-B(I)
1450 NEXT I
1460 GOSUB1960
1470 IF T0>MX THEN T0=MX
1490 IF MX>0 THEN 910
```

Listing 1 continued on page 254

```
REM   MERGE SORT USING LINK () FOR INDEX
FUNCTION      MERGE (I,J=INTEGER)=INTEGER
          VAR T,KM,M=INTEGER
          IF ARRAY (I) <ARRAY (J) THEN
                 BEGIN
                            M=I
                            I=J
                            J=M
                 END
          T=I
          KM=T
          I=LINK (I)
          WHILE I<>0 DO
          BEGIN
                 IF ARRAY (I) <ARRAY (J) THEN
                            BEGIN
                                    M=I
                                    I=J
                                    J=M
                            END
                   LINK(KM)=I
                   KM=I
                   I=LINK(I)
          END
          LINK(KM)=J
          END=T
FUNCTION      SORT(IS,JS=INTEGER)=INTEGER
          VAR KS,II,JJ=INTEGER
          IF IS=JS THEN
                 BEGIN
                          LINK(IS)=0
                          RETURNED.VALUE=IS
                          GOTO  OEND
                 END
          KS=IS+((JS-IS)/2)
          II=SORT(IS,KS)
          JJ=SORT(KS+1,JS)
          RETURNED.VALUE=MERGE(II,JJ)
OEND      END=RETURNED.VALUE
```



Finally, a language to meet your needs

The new S-BASIC™ language has more computing power than any other true compiler BASIC in the industry.

S-BASIC™ is the ONLY CP/M™ compatible BASIC providing . . .

- Chainable .COM programs with parameter passing.
- Dynamically allocated arrays, sequential and random file buffers.
- Dynamically relocatable variables.
- Common, global, and local variables.
- A choice of: While-Do, Repeat-Until, Begin-End, If-Then-Else, and Case-Of Structures.
- Recursive, Multi-lined functions and procedures.
- Memory image disk storage (no conversions).
- CP/M 2 .xx enhancements usage as well as CP/M™ 1.4 x capable.
- 6 data types: Character, string, integer, single and double precision floating point, and packed BCD.

*CP/M is a registered trademark of Digital Research.

Besides all of these unique features, **S-BASIC™** offers long variable names, digit/string line labels (when required), relocatable code output, multiple libraries, external .COM program execution, all of the flexibility of an enhanced BASIC, and a multitude of conveniences that make programming a pleasure.

As a software house always looking for that ideal, powerful, new language . . . we're excited about making **S-BASIC™** available to the software community.

Order your copy now at an introductory price of $250. from

MICRO•AP, INC.
9807 Davona Drive
San Ramon, CA 94583
Telephone (415) 828-6697

MICRO•AP

*S-BASIC is a trademark of Topaz programming.

Listing 1 continued from page 252:

```
1500 CLS
1510 PRINT"THE PROCESS TERMINATED AFTER";K7;"STEPS"
1520 PRINT
1530 PRINT"THE SOLUTION IS"
1540 FOR I=1 TO N9
1550      PRINT"X(";I;")=";X0(I)
1560 NEXT I
1570 END
1580 '
1590 ' *****  SUBROUTINE ORT(F)  *****
1600 '
1610 K=1
1620 IF F(K)<>0 THEN 1630ELSE K=K+1 : GOTO1620
1630 FOR I=2 TO N9
1640 FOR J=1 TO N9
1650 W(J,I)=0
1660 IF J<K THEN I1=1 ELSE I1=0
1670 IF J=I-I1 AND J<>K LET W(J,I)=1
1680 NEXT J : NEXT I
1690 WN=0
1700 FOR J = 1 TO N9 : WN=F(J)*F(J)+WN : NEXT
1710 WN=SQR(WN)
1720 FOR I=1 TO N9 :V(I,1)=F(I)/WN : W(I,1)=V(I,1) : NEXT
1730 FOR I=2 TO N9
1740 FOR I1 = 1 TO N9
1750 V(I1,I)=W(I1,I)
1760 NEXT I1
1770 FOR J = 1 TO I-1
1780 L=0
1790 FOR J1=1 TO N9
1800 L=L+V(J1,J)*W(J1,I)
1810 NEXT J1
1820 FOR I1=1 TO N9
1830 V(I1,I)=V(I1,I)-L*V(I1,J)
1840 NEXT I1
1850 NEXT J
1860 WN=0
1870 FOR I2=1 TO N9
1880 WN=WN+V(I2,I)*V(I2,I)
1890 NEXT I2
1900 WN=SQR(WN)
1910 FOR I2=1 TO N9: V(I2,I)=V(I2,I)/WN
1920 NEXTI2
1930 NEXT I
1940 RETURN
1950 '
1960 '  **** FIND THE ELEMENT OF LARGEST ABSOLUTE VALUE  ****
1970 '  **** IN THE ARRAY B1                            ****
1980 '
1990 MX=(B1(1)) : I0=1
2000 FOR I= 2 TO M9
2010 IF B1(I) > MX LET MX=B1(I) : I0=I
2020 NEXT I
2030 RETURN
2040 '    @@@@@@@  THE HADAMARD INEQUALITY  @@@@@@
2050 PN=1 : FOR KZ = 1 TO N9 : FOR J=1 TO M9 : F(J)=A(KZ,J):NEXT J:MT=M9 : GOSUB
 2090  : GOSUB 1010 :B1(KZ)=NF:NEXT KZ
2060 FOR J=1 TO M9 : F(J)=B(J) : NEXT J : GOSUB 2090 : GOSUB 1010 : FOR J=1TO N9
-1 : F(J)=B1(J) : NEXT J :MT = N9 : GOSUB 2090
2070 FOR J= 1 TO N9-1 : PN=PN*F(J) : NEXT J :PN = PN*NF
2080 LL = INT(LOG(PN*SQR(N9))/LOG(2))+1 : GOTO 780
2090 I=1 : T=F(I) : KT=0 : K=I
2100 K=K+1 : IF K>MT LET K=I+KT : I=I+1 : IF I > MT RETURN ELSE T=F(I) : IF K=>M
T RETURN ELSE 2100
2110 IF T=> F(K) THEN 2100 ELSE T=F(K) : FOR J=K TO I+1 STEP -1 : F(J)=F(J-1) :
NEXT J : F(I)=T : KT=KT+1 : GOTO 2100
```

Text continued from page 246:
equalities and not exponentially, as in the Simplex method. An example showing this exponential growth of the number of steps in the Simplex algorithm was constructed in 1972 by Klee and Minty. It is interesting to see how our program reacts to this problem. We are indebted to Dr Philip Wolfe of IBM for showing us the following version of the Klee-Minty problem.

Let n be given. Let $\mathbf{c}^t = (10^{n-1}, 10^{n-2}, \ldots, 10^1, 1)$, $\mathbf{b}^t = (1, 10^2, 10^4, \ldots, 10^{2(n-1)})$ and:

$$A = \begin{bmatrix} 1 & 0 & 0 & \ldots & 0 \\ 2\times10^1 & 1 & 0 & \ldots & 0 \\ 2\times10^2 & 2\times10^1 & 1 & \ldots & 0 \\ \cdot & \cdot & & \cdots & \cdot \\ \cdot & \cdot & & \cdots & \cdot \\ \cdot & \cdot & & \cdots & \cdot \\ 2\times10^{(n-1)} & 2\times10^{(n-2)} & & \ldots & 1 \end{bmatrix}$$

The Simplex method takes $2^n - 1$ steps to find the solution of the linear programming problem (8). Running our program for Khachiyan's algorithm gave the results shown in table 1.

n	Number of steps for Simplex method	Number of steps for Khachiyan's method
1	1	35 (with ϵ = .01)
2	3	525 (with ϵ = .01)
3	7	2849 (with ϵ = .01)

Table 1: *A short comparison of the Simplex and Khachiyan algorithms. Although this comparison strongly favors the Simplex method, Khachiyan's algorithm would be consistently better, given problems of a sufficiently large size.*

Although this data seems to reflect unfavorably on Khachiyan's method, it must be noted that this is only for small problems. Khachiyan's method would certainly require less steps than the Simplex method in some real-world situations, where a typical industrial problem may involve 10,000 inequalities and 50,000 variables. Far more experience with Khachiyan's method will be required to decide whether its theoretical advantage is of practical value.

We wish to thank the C W Post Research Committee for providing financial support for the preparation of this article. ■

REFERENCES

1. Asprall, B and R E Stone, "Khachiyan's Linear Programming Algorithm," *Journal of Algorithms*, March 1980.
2. Gâcs, P and L Lovâsz, "Khachiyan's Algorithm for Linear Programming," to appear.
3. Khachiyan, L G, "A Polynomial Algorithm in Linear Programming," (in Russian), *Doklady, the Proceedings of the Academy of Sciences of the USSR*, volume 244 (1979), number 5, pages 1093 thru 1096.
4. Kolata, G B, "Mathematicians Amazed by Russian's Discovery," *Science*, November 2, 1979, volume 206, number 4418, pages 545 thru 546.
5. *New York Times*, November 7, 11, and 27, 1979.
6. Steen, L A, "Linear Programming: Solid New Algorithm," *Science News*, October 6, 1979, volume 116, pages 234 thru 236.

Clubs and Newsletters

Connecticut H-8 Users

Meet and exchange ideas with fellow Heath H-8, H-9 and H-89 users. Monthly meetings are held. For more information, contact Ron Lawson, 395 W Main St, Avon CT 06001.

Z-Users Group

The Z-Users Group is devoted to the Pascal/Z compiler and Z80 and Z8000 software. The purpose of the group is to assist the public in using, improving, and exchanging software. A flyer is issued bimonthly with bug notes, fixes, and other features of interest. Public-domain programs are also being distributed. A disk full of software, running under CP/M, single-sided, single density, is available free. There are no membership fees, but the flyer costs $6 per year. Contact Z-Users Group, 7962 Center Pky, Sacramento CA 95823.

NICHE

The Northern Indiana Computer Hobbyist Exchange (NICHE) meets the last Monday of almost every month. Meetings are open to all computer enthusiasts. For more information, contact Eric Bean, 927 S 26th St, South Bend IN 46615.

Upstate New York Apples

The Upstate Apple Users Group meets on the third Thursday of the month at 7 PM at Upstate Computer Shop, 629 French Rd, Campus Plz, New Hartford NY 13413. The group is recognized by the International Apple Corps. The group's objectives are: to help newcomers solve hardware and software problems, aid in resources for education and hobbyists, and investigate the use of computers in the area of the handicapped. Contact Tony Violante at the store address above. On The Source, send mail to TCC788 Attn: Tony Violante.

Sol/Helios II Users

ASCII is a group for users of the Sol/Helios II system, which is utilized as a business system. A quarterly newsletter is published dedicated to Sol support and operations. Contact J Brockway, Suite 308, 2909 Bay to Bay, Tampa FL 33609.

MP/M Users Group

Digiac Corporation has formed MAPS (Multiple Application Processing Systems), a national MP/M users group. Digiac will operate the users group with the purpose of disseminating and sharing MP/M data and operational programs with all business and professional users of MP/M. Contact the club at Digiac Corporation, 175 Engineers Rd, Smithtown NY 11787, (516) 273-8600.

Sell, Trade, and Buy

Sell and trade software through this club. Buy one $6 tape or one $9 floppy disk per month. Submit software and receive $2 per program for each copy sold nationwide. Buy and sell used equipment. For further information, send stamped, self-addressed envelope to K Reynolds, 11815 SE 208, Kent WA 98031, (206) 630-0517.

Software Rental Club

The Goldcoast Computer Rental Club is now seeking members. They have a library of programs for rent. The programs are selected, tested, and reviewed by their staff. The library consists of over 3000 programs from sixteen categories for the Apple II and the TRS-80. The *Goldcoast Newsheet* contains programming tips, shortcuts, and other items. A $10 yearly fee entitles members to a free disk of programs. For information, write Goldcoast Rental Club, POB 181, Bremen KY 42325.

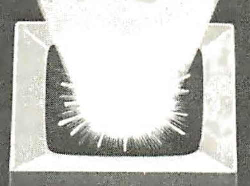
A McGRAW-HILL PUBLICATION

onComputing™

GUIDE TO PERSONAL COMPUTING

GETTING STARTED
What You Need And What It Will Cost
EQUIPMENT REVIEWS
TRS-80, Apple, Sorcerer and PET
Best-Selling Author
JERRY POURNELLE
"Writing With A Microcomputer"
THE BINARY WORLD
Also...
A PERSONAL COMPUTER DIRECTORY
COMPUTER CLUBS: WHO NEEDS THEM?
Plus much much more for the new computer user

When will the Personal Computer Explosion touch YOU?



Are you prepared for the explosive transformation? Right in your own home? Electronic mail. Personalized investment analysis. Foreign language tutorial. Home energy management. Robots. Computer music. Secretarial service. Diet and menu planning. And more, more, more.

onComputing,™ the new McGraw-Hill quarterly, prepares you for the enormous changes coming during the 1980's (Some are already here). **onComputing™** explains in nontechnical language what personal computers are, how they work, and how you can use them at home, for fun and profit.

Don't let the personal computer explosion catch you off guard. Know what's happening and help make it happen! Prepare now for the exciting future with a subscription to **onComputing™**!

Call Toll-Free 800-258-5485

Start your subscription today.

onComputing™ Subscription Dept. P.O. Box 307, Martinsville, NJ 08836

DOMESTIC subscription rate:
☐ U.S. 1 yr. (4 issues) @ $8.50 ☐ Canada & Mexico, 1 yr. (4 issues) @ $10.00
FOREIGN (to expedite service, please remit in U.S. funds drawn on a U.S. bank.)
☐ Europe (and all other countries, except above), 1 yr. @ $12.00 — surface delivery.

☐ Bill Visa ☐ Bill Master Charge ☐ Bill me (North America only)

Card Number ____ Expiration ____

Signature ____ Name (please print) ____

Street/Apartment Number ____

City ____ State/Province/Country Code ____

7B90

Please allow 6-8 weeks for processing.

Forming SuperBrain Users Group

SuperBrain users who desire to exchange ideas and information should contact SuperBrain Users Group, Howard Van Jepmond, 420 French Ct, Menlo Park CA 94025.

North Star Users Group Recognized by the Parent Company

The International North Star Users Association (INSUA) is recognized by the North Star company to provide liaison, feedback, and fixes for users of North Star's computers or disk operating systems running on other computers. The association hopes to act as a link between local users groups, individual North Star computer users, and the Berkeley, California, company. The group's charter calls for it to act as a source of information for new and advanced North Star users; to publish a quarterly newsletter for members, including application and programming techniques; to maintain and distribute a users public-domain software library; and to act as an independent representative to make users' needs known to North Star Computers Inc. The yearly dues are $15, which includes a subscription to the newsletter as well as access to all the group's software and hardware distribution. INSUA can be contacted at 131 Highand Ave, Vacaville CA 95688, (707) 448-9055.

Southern Colorado Computer Club

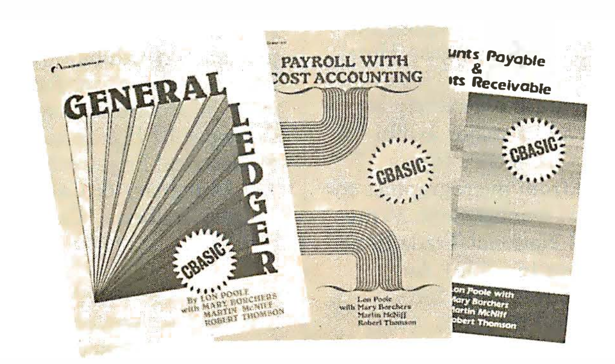
The Southern Colorado Computer Club (SCCC) meets on the first and third Tuesdays of each month. Apple, Atari, Texas Instruments, and PET computers are among the systems represented. Classes and seminars will be scheduled for future meetings. Subjects will range from equipment hardware to programming and will include information on how to go about selecting the right computer for personal or business use. Write to the club at the Computer Shack, Gibson Shopping Center, 1635 S Prairie, Pueblo CO 81005, (303) 564-3545.

Evansville Computer Club

This group meets at Hutch and Sons on the second Wednesday of each month at 7 PM. Hutch and Sons is located on the corner of Franklin and N Main streets in Evansville, Indiana. Sol, Bally, Altair, IMSAI, Heath, Elf, and TRS-80 are some of the systems used by members. Send a stamped, self-addressed envelope to Bob Heerdink, Evansville Computer Club, C/O National Sharedata Corporation, POB 3895, Evansville IN 47737. ■

More from Osborne/McGraw-Hill

Osborne/McGraw-Hill means documented software



NOW AVAILABLE

OSBORNE/McGraw-Hill's popular business software series **in CBASIC-2!**

Thoroughly tested, reliable programs with complete source listings, our **Payroll with Cost Accounting, Accounts Payable and Accounts Receivable** and **General Ledger** tell you how to begin; how to make changes; how to turn your computer into a productive part of your business. Printed in a loose-leaf format, easily inserted into your own binder, you can add to the book as you add to the programs.

DEALERS: The source listings from each book are available on disk for just $250 — with no licensing agreements. Call or write for our dealer information package.

The books are also available in Wang BASIC. (Wang users must supply KFAM.)

Z80 · 6800 · 8080A/8085 · 6502 · Z8000 · 6809

Assembly Language



Programming Primers for the most popular Microcomputers

New! **Z8000** | **Available Now** **6809**

These **Assembly Language Programming** books view assembly language as a means of programming a microcomputer system. Each book explains assembly language programming, describes the functions of assemblers and assembly instructions, and discusses basic software development concepts. A special section on structured programming rounds out the discussion of programming examples, which range from simple memory load loops to complete rudimentary design projects. Each book includes comprehensive coverage of the particular assembly language, and presents a large number of fully debugged, practical programming examples written in the language of interest.

The 8086 Book New!

A handbook for all 8086 users, **The 8086 Book** includes basic 8086 programming instructions, a thorough analysis of the 8086 instruction set, and detailed hardware and interfacing guides that reveal the full power of the 8086 multiprocessing capabilities.

Order Form

Title	Quantity	Price	Amount
8080A/8085 ALP		$12.50	
Z80 ALP		$12.50	
6800 ALP		$12.50	
6502 ALP		$12.50	
Payroll with Cost Accounting - CBASIC		$20.00	
Accounts Payable/Receivable - CBASIC		$20.00	
General Ledger - CBASIC		$20.00	
Z8000		$12.50	
6809 ALP		$12.50	
8086		$15.00	
Tax — Calif. residents only 6%/6½% BART		Tax	
		Shipping	
		TOTAL	

Please send me business software information package for:
□ end user □ dealer.

Shipping: (Shipping for large orders to be arranged)
- □ All foreign order $4.00 per book for airmail
- □ $0.75 per book 4th class in the U.S. (allow 3-4 weeks)
- □ $1.25 per book UPS in the U.S. (allow 10 days)
- □ $2.50 per book special rush shipment by air in the U.S.

For faster shipment or credit card, phone (415) 548-2805

Name: ______________________

Address: ______________________

City: ______________ **State:** ________

ZIP: ________ **Phone:** ______________



630 Bancroft Way, Dept. B8
Berkeley, California 94710
(415) 548-2805 TWX 910-366-7277



Event Queue

September 1980

September-October

Computer Sales Workshops. Datasearch is offering one-day workshops throughout the nation covering sales techniques for managers and salespeople. For details, call or write Datasearch Inc, 4954 William Arnold Rd, Memphis TN 38117, (901) 761-9090.

September-November

Thinking Small—Using Small Computers to Increase Business Productivity. These conferences will feature leading authorities and small-business computer users in a program designed to explore the opportunities presented by small computers for the improvement of productivity in the small-business situation. For a schedule of times and places, contact The Information Exchange, 1730 N Lynn St, Suite 400, Arlington VA 22209, (703) 521-6209.

September-January

Twenty-nine Seminars from DPMA Education Foundation. The DPMA (Data Processing Management Association) is sponsoring a series of two-day, computer-oriented seminars. Data processing, software configuration management, computer-aided design and manufacturing, computers and data communications, data base, integrated circuits, and software engineering are some of the topics that will be covered. For details on site locations and times, contact DPMA Education Foundation Coordinator, 5959 W Century Blvd, Los Angeles CA 90045, (213) 670-2975.

September 8-10

Government Micrographics Conference and Exposition, Sheraton Washington Hotel, Washington DC. This event will feature over thirty sessions and a major exhibition. Conference topics range from micrographics to general management. Write or call National Trade Productions Inc, 9301 Annapolis Rd, Suite 206, Lanham MD 20801, (301) 459-1815.

September 9-10

The Thirteenth International Symposium and Exhibition on Minicomputer and Microcomputer Applications, MIMI'80, Montreal, Canada. This symposium will cover communications, signal processing, data acquisition, control, robotics, education, hardware, languages, networks, and other topics. It is being held in conjunction with the first IASTED International Symposium and Exhibition on Office Automation. For more information, contact Professor M H Hamza, Dept of Electrical Engineering, The University of Calgary, Calgary, Alberta, Canada I2N 1N4.

September 11-13

Internepcon Semiconductor International Exposition and Conference, Republic of Singapore. Featuring an exhibition of production machinery, tools, hardware, materials, and test instruments, the show includes conferences keyed to the needs of engineering, manufacturing, and support personnel of Southeast Asia. It is open to all persons engaged in electronics and semiconductor manufacturing. Contact Industrial & Scientific Conference Management Inc, 222 W Adams St, Chicago IL 60606, (312) 263-4866.

September 16-18

Euromicro '80, London, England. Euromicro '80 will consist of scientific, short-notes, and industrial sessions. This annual international event is highlighted by read papers and discussions. In addition, microprocessor-controlled robot mice will race against time or will show off their prowess in an "open world" environment when the European finals of the Amazing Micromouse Maze contest are held. For information, contact Lionel R Thompson, HSDE, Hatfield AL 109LP, England.

September 16-18

Wescon/80, Anaheim Convention Center, Anaheim CA. This year's show will include a large exhibition and a variety of talks covering communications, computers and microprocessors, consumer electronics, energy, office automation

CP/M* compatible software

SYSTEM MAINTENANCE

DIAGNOSTICS I: Easily the most comprehensive set of CP/M compatible system check-out programs ever assembled. Finds hardware errors in your system, confirms suspicions, or just gives your system a clean bill of health.

Tests:
- Memory
- CPU (8080/8085/Z80)
- Terminal
- Disk
- Printer

To our knowledge the CPU test is the first of its kind anywhere. Diagnostics I can help you find problems before they become serious. A good set of diagnostic routines are a must in any program library.

Minimal requirements: 24K CP/M. Supplied with complete user manual: $60.00 Manual alone: $15.00.

ACCOUNTING

ACCOUNTS PAYABLE/RECEIVABLE: A complete, user oriented package which features:

automatic postings to general ledger (optional)

accounts payable:
- check printing with invoice
- invoice aging

accounts receivable:
- progress billing
- customer statements
- partial invoice payments
- invoice aging

The entire package is menu driven and easy to learn and use. It incorporates error checking and excellent user displays. This package can be used stand alone or with the General Ledger below.

Supplied with extensive user manual: $200.00. Manual alone: $20.00.

GENERAL LEDGER: A complete, user oriented package which features:
- Accepts postings from external programs (i.e. AP/AR above)
- Accepts directly entered postings
- Maintains account balances for current month, quarter, and year and previous three quarters
- Financial reports: trial balance, income statement balance sheet, and more.

Completely menu driven and easy to learn and use. Excellent displays and error checking for trouble free operation. Can be used stand alone or with Accounts Payable/Receivable above.

Supplied with extensive user manual: $200.00. Manual alone: $20.00.

Both require 48K CP/M, terminal with cursor positioning, home and clear home, one 8" disk or Two 5" disks. CBASIC2 required.

TEXT PROCESSING

TFS—Text Formatting System: An extremely powerful formatter. More than 50 commands. Supports all major features including:
- left & right margin justification
- user defined macros
- dynamic insertion from disk file
- underlining and backspace

TFS lets you make multiple copies of any text. For example: Personalized form letters complete with name & address & other insertions from a disk file. Text is not limited to the size of RAM making TFS perfect for reports or any big job.

Text is entered using CP/M standard editor or most any CP/M compatible editor. TFS will link completely with Super-M-List making personalized form letters easy.

Requires: 24K CP/M.

Supplied with extensive user manual: $85.00. Manual alone: $20.00.

Source to TFS in 8080 assembler (can be assembled using standard CP/M assembler) plus user manual: $250.00.

MAILING LIST

SUPER-M-LIST: A complete, easy to use mailing list program package. Allows for two names, two address, city, state, zip and a three digit code field for added flexibility. Super-M-List can sort on any field and produce mailing labels direct to printer or disk file for later printing or use by other programs. Super-M-List is the perfect companion to TFS. Handles 1981 Zip Codes!

Requires: 48K CP/M.

Supplied with complete user manual: $75.00. Manual alone: $10.00

UTILITIES

Utility pack #1: A collection of programs that you will find useful and maybe even necessary in your daily work (we did!). Includes:

CMP: Compare two files for equality.
ARCHIVER: Compacts many files into one. useful when you run out of directory entries.
SORT: In core sort of variable length records.
XDIR: Extended, alphabetical directory listing with groupings by common extension.
PRINT: Formatted listings to printer.
PG: Lists files to CRT a page at a time.
. . . plus more . . .

Requires: 24K CP/M.

Supplied with instructions on discette: $50.00

PROGRAMMING LANGUAGES

FORTH: a full, extended FORTH interpreter/compiler produces COMPACT, ROMABLE code. As fast as compiled FORTRAN, as easy to use as interactive BASIC.

SELF COMPILING: Includes every line of source code necessary to recompile itself.
EXTENSIBLE: Adds functions at will.
Z80 & 8080 ASSEMBLERS included
Single license, OEM licensing available
Please specify CPU type: Z80 or 8080
Supplied with extensive user manual and tutorial: $150.00
Documentation alone: $25.00

ENHANCED 'TINY' PASCAL: We still call it 'Tiny' but it's bigger and better than ever! This is the Famous Chung/Yuen 'Tiny' Pascal with more features added. Features include:
- recursive procedures/functions
- integer arithmetic
- CASE
- FOR (loop)
- sequential disk I/O
- one dimensional arrays
- IF . . . THEN . . . ELSE
- WHILE
- 'PEAK' & 'POKE'
- READ & WRITE
- REPEAT . . . UNTIL
- more

'Tiny' Pascal is fast. Programs execute up to ten times faster than similar BASIC programs.

SOURCE TOO! We still distribute source, in 'Tiny' Pascal, on each discette sold. You can even recompile the compiler, add features or just gain insight into compiler construction.

'Tiny' Pascal is perfect for writing text processors, real time control systems, virtually any application which requires high speed. Requires: 36K CP/M. Supplied with complete user manual and source on discette: $85.00.

Manual alone: $10.00.

SOFTWARE SECURITY

ENCODE/DECODE: A complete software security system for CP/M. Encode/Decode is a sophisticated coding program package which transforms data stored on disk into coded text which is completely unrecognizable. Encode/Decode supports multiple security levels and passwords. A user defined combination (One billion possible) is used to code and decode a file. Uses are unlimited. Below are a few examples:
- data bases
- general ledger
- inventory
- payroll files
- correspondence
- accounts pay/rec
- programs
- tax records
- mailing lists

Encode/Decode is available in two versions:

Encode/Decode I provides a level of security suitable for normal use. Encode/Decode II provides enhanced security for the most demanding needs. Both versions come supplied on discette and with a complete user manual.

Encode/Decode I: $50.00
Encode/Decode II: $100.00 Manual alone: $15.00

INTERCOMPUTER COMMUNICATIONS

TERM: a complete intercommunications package for linking your computer to other computers. Link either to other CP/M computers or to large timesharing systems. TERM is comparable to other systems but costs less, delivers more and source is provided on discette!

With TERM you can send and receive ASCII and Hex files (COM too, with included convertion program) with any other CP/M computer which has TERM or compatible package. Allows real time communication between users on separate systems as well as acting as timesharing terminal.
- Engage/disengage printer
- error checking and auto retry
- terminal mode for timesharing between systems
- conversational mode
- send files
- receive files

Requires: 32K CP/M.

Supplied with user manual and 8080 source code: $110.00

Manual alone: $15.00.

CP/M Formats: 8" soft sectored, 5" Northstar, 5" Micropolis Mod II, Vector MZ

All Orders and General Information:
SUPERSOFT ASSOCIATES
P.O. BOX 1628
CHAMPAIGN, IL 61820
(217) 359-2112
Technical Hot Line: (217) 359-2691
(answered only when technician is available)

VISA

master charge

SuperSoft
First in Software Technology

*CP/M REGISTERED TRADEMARK DIGITAL RESEARCH

and semiconductor technology, and more. Contact Wescon, 999 N Sepulveda Blvd, El Segundo CA 90245, (213) 772-2965.

September 17-19

ACM Small/Personal Computer Conference, Rickey's Hyatt House, Palo Alto CA. This symposium will blend contributed papers, panel, and informal discussions. Hardware and software topics involving theory, design, construction, marketing, and application will be included. Discussions will cover microcomputer applications in business, industry, education, and the home. Details are available from Conference Chairman, Philippe Lehot, PLA, 976 Longridge Rd, Oakland CA 94610.

September 18-21

Mid-Atlantic Business and Home-Computer Show, DC Armory/Starplex, Washington DC. This is an end-user exposition featuring small- and medium-sized business systems, scientific and engineering computers, microcomputers, and electrotechnology. Contact Northeast Expositions Inc, POB 678, Brookline Village MA 02147, (617) 739-2000.

September 22-25

Software INFO, Hyatt Regency, Chicago IL. This is the first national conference and exhibit on packaged software held in the US. For more information, or to reserve space, call (312) 263-3131 or write Software INFO, Suite 545, 222 W Adams St, Chicago IL 60606.

September 23-25

Compcon '80 Fall, Capital Hilton Hotel, Washington DC. Sponsored by the IEEE (Institute of Electrical and Electronics Engineers), this show is concerned with distributed computing and related topics. Discussions will cover interfaces, standards, and protocols; data communications and networking; computer systems; data bases; security; office systems; and more. Details from Compcon '80 Fall, POB 639, Silver Spring MD 20901, (617) 879-2960.

September 24-27

The Tenth Annual Conference of the Society for Computer Medicine, San Diego Hilton, San Diego CA. This conference has been planned for physicians, attorneys, administrators, computer professionals, comptrollers, engineers, nurses, and anyone interested in the use of computers for patient care. Sessions on medical subjects, technical subjects and contributed papers on new research in computer medicine will be offered. For information, contact Society for Computer Medicine, 1901 N Ft Myer Dr, Suite 602, Arlington VA 22209, (703) 525-0098.

September 25-28

Mid-Atlantic Personal and Business Computer Show, Philadelphia Civic Center, Philadelphia PA. General admission for adults is $5. The show is being produced by National Computer Shows, POB 678, Brookline Village MA 02147, (617) 739-2000.

September 25-29

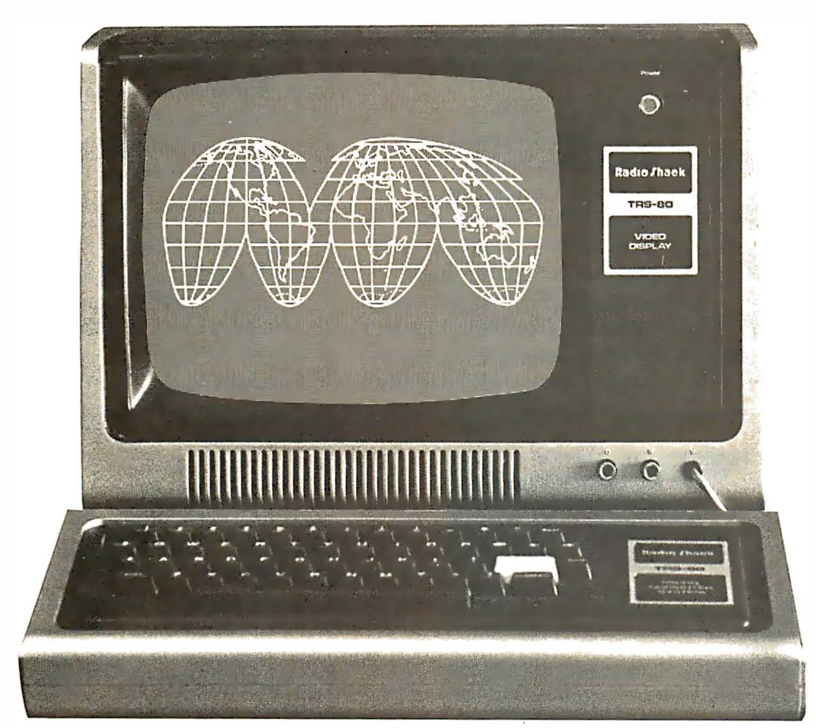
The Third World Computer Chess Championship, Brucknerhaus, Linz, Austria. This tournament will be a four- or five-round Swiss-style competition with participants restricted to computer chess programs. The current world and North American champion, CHESS 4.9 of Northwestern University, will return to defend its title. Also expected to participate are the former world champion, KAISSA, from the Moscow Institute of System Studies; MASTER, the current European champion; BELLE, CHAOS, DUCHESS, and other programs from Europe, the US, and Canada. For information in the US, contact Professor M M Newborn, School of Computer Science, McGill University, Montreal, Quebec H3A 2K6 Canada. In Europe, contact Frederic Friedel, Hauptstrasse 28B, 2114 Hollenstedt, West Germany (BRD).

September 26-27

Classroom Applications of Computers in Grades K thru 12, Independence High School, San Jose CA. Tutorials, workshops, exhibits, and a trip to "Silicon Valley" will highlight this conference. The emphasis will be to inform teachers about the possible uses of computers in all areas of education. Contact Computer-Using Educators, c/o W Don McKell, Independence High School, 1776 Educational Park Dr, San Jose CA 95133.

September 30-October 2

Computer Crime: Investigation and Prosecution, San Francisco CA. This workshop is designed for security and law enforcement investigators, prosecutors, attorneys, and computer specialists who have



CompuServe's information service.

A world of information available. Right now.

If you have a personal computer—or a computer terminal — CompuServe can bring a world of information into your home or small business.

CompuServe

CompuServe is a major computer services company that has been serving top industrial and governmental clients for more than a decade. Now we're also applying our extensive computing capacity to the delivery of information services to your personal computer.

The Information Service

This exciting service is available in more than 250 cities between 6 p.m. and 5 a.m. weekdays, all day weekends and most holidays. Cost? Only $5.00 per hour billed in minutes. All you need is a 300 baud modem, and our complete information service is only a local phone call away.

Welcome to CompuServe's information service.

- *News. Weather. Sports.* Major regional newspapers. Plus international news services.
- *Finance. MicroQuote.* Updates and historical information on stocks, bonds and commodities.
- *Entertainment.* Theatre, book, movie and restaurant reviews. Plus opera, symphony, ballet, dance, museums, galleries...
- *Electronic Mail.* Create, edit, send and receive messages from any other CompuServe user... nationwide.
- *Home & Educational Reference Service.* Anything you want to know... from encyclopedia information to household tips.
- *CompuServe User Information.* In case you need technical help ... and information on new services as they become available.
- *MicroNET.* For the computer hobbyist. Software Exchange, line printer art gallery, challenging games, programming languages, word processing, business & educational programs ... and much, much more.

And this is just the beginning. CompuServe is continually adding to its list of available services. The world of electronic information isn't coming tomorrow. It's here today.

CompuServe is Available at Radio Shack® Stores

Your local Radio Shack® Store Sells CompuServe's information service. There are more than 6,000 Radio Shack® Stores and Dealers nationwide. Check with the outlet nearest you.

Radio Shack is a division of Tandy Corporation.

CompuServe

Information Service Division
5000 Arlington Centre Blvd.
Columbus, Ohio 43220
(614) 457-8600

had training or experience in investigating financial or computer crimes. The fee is $575. For more information, contact Paul Shaw, *Assets Protection Journal,* 500 Sutter St, Suite 503, San Francisco CA 94102, (415) 392-2955.

October 1980

October 1-2

Choosing and Using Microprocessor Development Systems, London Press Centre, London, England. This seminar will present information and practical experience on which to base the selection and use of microprocessor-development systems. It will provide guidelines to answer questions on the definition of microprocessor-development systems, what features should be looked for, how to analyze particular requirements, and what systems are commercially available. The program is intended for senior engineers and engineering managers who have some knowledge of microprocessors. Contact the Conference and Courses Unit, Sira Institute Ltd, South Hill, Chislehurst, Kent BR7 5EH, England.

October 1-3

The Tenth International Symposium on Fault-Tolerant Computing, Kyoto, Japan. This meeting is devoted to the theory and practice of reliable computing and will cover design of fault-tolerant circuits and systems, analysis of system performance and reliability; applications of coding techniques, software reliability and testing, and more. For information and traveling arrangements, contact Secretary of FTCS-10, Dept of Applied Mathematics and Physics, Faculty of Engineering, Kyoto University, Kyoto 606 Japan.

October 6-8

APL Users Meeting, Toronto, Canada. This conference is aimed at APL users as well as those considering the use of APL in their systems. Speakers will present papers which discuss the practical use of APL. Managing APL resources, teaching APL, and APL programming techniques will also be covered. The registration fee is $180 (in Canadian funds), which includes a copy of the proceedings. For a brochure and registration material, contact Rosanne Wild, I P Sharp Associates Ltd, 145 King St W, Toronto, Ontario, M5H 1J8, Canada.

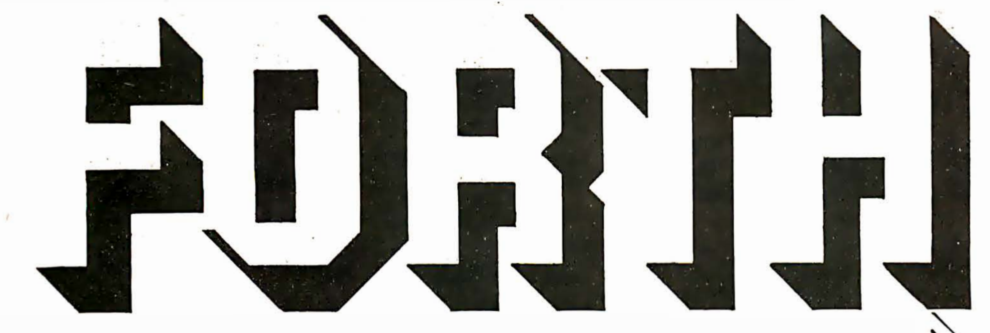
October 8-10

Circulation Computer Systems Symposium, Chicago Marriott Hotel, Chicago IL. More than 425 newspaper publishers, general managers, circulation directors, controllers, and data-processing managers are expected to attend this symposium. Workshop sessions will be held for participants who already have or who are considering automated circulation systems. For more information, contact American Newspaper Publishers Association, The Newspaper Center, POB 17407, Dulles Airport, Washington DC 20041, (703) 620-9500.

October 14-16

Minicomputer and Microcomputer Conference and Exposition, Brooks Hall/Civic Auditorium, San Francisco CA. Contact Managing Director, Mini/Micro Conference and Exposition, 32302 Camino Capistrano, Suite 202, San Juan Capistrano CA 92675, (714) 661-3301.

StackWork's



A full, extended FORTH interpreter/compiler produces COMPACT, ROMABLE code. As fast as compiled FORTRAN, as easy to use as interactive BASIC.

SELF COMPILING
Includes every line of source code necessary to recompile itself.

EXTENSIBLE
Add functions at will.

CP/M* COMPATIBLE

Z80 & 8080 ASSEMBLERS included

Single license
Supplied with extensive user manual and tutorial: $150.00
Documentation alone: $25.00

OEM's, we have a deal for you!

CP/M Formats: 8" soft sectored, 5" Northstar, 5" Micropolis Mod II.

Please specify CPU type
Z80 or 8080

All Orders and General Information:
SUPERSOFT ASSOCIATES
P.O. BOX 1628
CHAMPAIGN, IL 61820
(217) 359-2112
Technical Hot Line: (217) 359-2691
(answered only when technician is available)







*CP/M registered trademark Digital Research

October 16-19
Midwest Personal and Business Computer Show. For more information on this exposition, contact National Computer Shows, POB 678, Brookline Village MA 02147, (617) 739-2000.

October 26-28
The Eleventh ACM North American Computer Chess Championship, Opryland Hotel, Nashville TN. This is a four-round Swiss-style tournament with participants restricted to computers. All of the best chess programs in North America are expected to participate. A maximum of twelve teams will participate. The deadline for entries is September 8, 1980. Contact Monty Newborn, School of Computer Science, McGill University, 805 Sherbrooke St W, Montreal, PQ, H3A 2K6, Canada,(514) 392-8274.

October 26-29
International Data-Processing Conference and Business Exposition, Philadelphia Sheraton Hotel, Philadelphia PA. This conference is being sponsored by the Data Processing Management Association. Contact the Conference Coordinator, DPMA International Headquarters, 505 Busse Hwy, Park Ridge IL 60068, (312) 825-8124.

October 27-29
ACM Annual Conference—Previewing the Computer Age, Opryland Hotel, Nashville TN. This conference will focus on the computer technology, products, and services that will come into general use during the 1980s. The technical program will be organized around the Association for Computing Machinery's (ACM) Special Interest Groups, with additional sessions for papers of general interest. Contact Dr Gordon Sherman, Technical Program Chairman, ACM '80, University of Tennessee Computer Center, Knoxville TN 37916, (615) 974-6758.

October 27-30
The Fifth International Conference on Computer Communications, Peachtree Plaza Hotel, Atlanta GA. The theme for ICCC/80 is "Computer Communications: Increasing Benefits for Society." More than one hundred speakers will present papers on applications and technical developments of computer communication and assess their worldwide implications for the 1980s. Fees are $175 for preregistration and $200 at the conference. Contact ICCC/80, POB 280, Basking Ridge NJ 07920, (201) 221-8800.

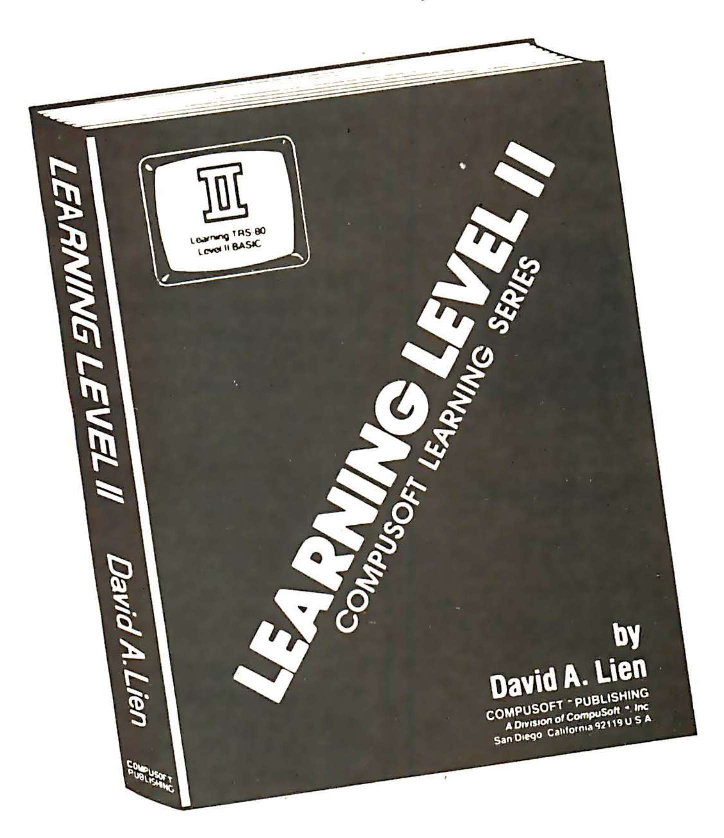
October 28-30
The Fourth Annual Interface West, Los Angeles Convention Center, Los Angeles CA. More than one hundred fifty computer-related companies will exhibit their wares. The conference will offer programs on office automation and small-systems procedures for businessmen, plus data communications, distributed-data processing, and networking for technically oriented managers. Many speakers will be featured. For further information, contact The Interface Group, 160 Speen St, Framingham MA 01701, (617) 879-4502 or call toll free, (800) 225-4620.

October 30-November 1
National Small-Computer Show, New York Coliseum, New York NY. Hourly lectures on data-processing and word-processing applications for small computers, exhibitions of hardware and software, and seminars on various aspects of computer-related news will be featured. A lecture schedule and basic information are available from the National Small Computer Show, 110 Charlotte Pl, Englewood Cliffs NJ 07632, (201) 569-8542.

NOVEMBER 1980

November 8-9
The 1980 Personal Computer Fair, Pacific Science

Here's The Second Half . . . . .



Second Edition
$15.95
(soft cover)

Written by the author of your Level II Users Manual, LEARNING LEVEL II picks right up where the Level I Manual leaves off. It even supplies the changes needed to make the Level I Manual compatible with your Level II TRS-80.

LEARNING LEVEL II covers all Level II BASIC beyond Level I, plus much more. It shows you how to use the Editor, explains what the many error messages are really saying, and leads you thru conversions of Level I programs to Level II.

Dual cassettes, the Expansion Interface with Real Time Clock, use of printers and other features are explained in the same easy-to-learn style that made the Level I Manual famous. LEARNING LEVEL II was created specifically for your Level II TRS-80!

VISA

Yes, I want to LEARN Level II!



COMPUSOFT™ PUBLISHING • 1050 E B Pioneer Way • El Cajon, CA 92020
(714) 588-0996

Please send ________ copies of LEARNING LEVEL II. My check for $15.95 each + $1.45 P&H is enclosed. (CA addresses add 6% sales tax).

I understand my order will be shipped promptly and there is a 30 day money-back guarantee.

NAME ____________________
ADDRESS ____________________
CITY ____________________
STATE ____________________
ZIP CODE ____________________

Center, Seattle WA. The theme of this year's fair is "Hands On." The booths and exhibits will reflect this idea, and the public will have access to as many computers and terminals as possible. Contact the Northwest Computer Society, POB 4193, Seattle WA 98119, (206) 284-6109.

November 10-14

The Fourth Annual Data-Entry Management Conference, Orlando FL. This conference will cover data entry, distributed processing, and word processing with emphasis on data entry, including human-machine interface. Contact Data Entry Management Association, POB 3231, Stamford CT 06905, (203) 322-1166.

November 18-20

The Third Industrial Revolution, McCormick Place, Chicago IL. This exposition and conference is devoted to development by manufacturing companies of systems for information management. Information may be obtained from Banner & Grief Ltd, 110 E 42nd St, New York NY 10017, (212) 687-7730.

November 19-21

Comdex '80, Las Vegas Convention Center, Las Vegas NV. Comdex is a conference and exposition for independent sellers of small-computer and word-processing systems, peripherals, media, and supplies. Address inquiries to the Interface Group, 160 Speen St, Framingham MA 01701, (800) 225-4620, in Massachusetts call (617) 879-4502.

November20-21

Western Educational Computing Conference, San Diego CA. This seminar will feature papers and seminars on the use of computing in higher education for instruction, administration, and research. Contact Ron Langley, Director, Computer Center, California State University, Long Beach, 1250 Bellflower Blvd, Long Beach CA 90840, (213) 498-5459.

November 20-23

Northeast Personal and Business Computer Show, Hynes Auditorium, Boston MA. This is an annual exposition open to the general public. The admission will be $5. Contact National Computer Shows, POB 678, Brookline Village MA 02147, (617) 739-2000.

November 21-23

National Home Entertainment Show, New York Coliseum, New York NY. Exhibits will cover video, photography, audio, games, and home computers. Seminars and demonstrations will be featured in this show. Contact United Business Publications Inc, 475 Park Ave South, NewYork NY 10016, (212) 725-2300. ■

BYTE's Bugs

An Error in Fifteen

I enjoyed seeing my article "Fifteen: A Game of Strategy" appear in the June 1980 BYTE (page 230). Unfortunately a bug crept into the program (listing 1), and it will **not** run as listed. The problem is in line 720, which should read:

"IF T2>0 THEN 750"

rather than "IF T2>0 THEN 270". With this change it runs as it should.

If the EXIT statements are dropped and the PRINT statements changed, then the program runs very nicely on a TRS-80 under Level II BASIC.

John Rheinstein
10 Gould Rd
Lexington MA 02173■

Exploring Ballistics with Your Computer

Robert W Jenks
POB 962
Islamorada FL 33036

Many sports are intricately involved with the properties of objects lofted into the air and thereby committed to the inevitable effects of gravity. Both players and fans relish golf's hole-in-one, the long bomb to the wide receiver in football, and the home run in baseball. In the case of target shooting, the path of the projectile is of particular interest. How the bullet gets to the target is the province of physics, but where it lands resides solely in the skill of the shooter. BALISTIC is a program to calculate just where a bullet will go.

Ballistics

Ballistics is the study of the behavior of projectiles at various ranges. Of interest to shooters are the velocity, time of flight, drop, and drift at evenly incremented ranges of 50 or 100 yards. Also of interest is the maximum height attained by the bullet above a horizontal line from the bore to a bull's-eye, the trajectory above and below a line of sight at various ranges, and the energy of the bullet.

A variety of factors influence the path of a bullet as it leaves the muzzle; most important are muzzle velocity, gravity, and air resistance. Muzzle velocity is determined by internal ballistics and factors such as bullet weight and bore diameter, barrel length, powder weight and burning rates, and maximum pressures. The calculation of these factors is beyond the scope of this article. Muzzle velocity depends upon the direction of the bore relative to the horizontal, since a velocity is formally a vector quantity. As it leaves the muzzle, though, the speed of the bullet can be most easily measured with an instrument called a *chronograph.* Bore elevations at reasonable ranges are typically less than a quarter of a degree, and therefore are of negligible influence. The acceleration of gravity is dependent on latitude and altitude (and thus on the distance to the center of the Earth), and upon local rock density and underlying mass. This, too, tends to minor deviations: only 0.5% from the equator to the poles, only 0.15% from sea level to 15,000 feet. The acceleration of gravity can be regarded as a constant 32.1725 feet per second per second in English system units.

Air resistance is the most complicated factor, and its effect is dependent on the density of the air, temperature (and thus the speed of sound), wind velocity, and the properties of the bullet—specifically, speed, sectional density (proportional to the ratio of mass to frontal area), and shape. Whereas gravity pulls the bullet toward the center of the Earth, air resistance acts as a drag opposite to its direction of motion at any instant. This effect of air resistance, independent of gravity (under usual conditions), determines the time of flight to any range and the remaining velocity. The effect of gravity combined with the influence of air resistance determines bullet drop at any range. Therefore, the calculations of the effects of the air naturally come first.

Air Resistance

The effect of the atmosphere is to push against the moving bullet. Because a force acting on a mass results in an acceleration or deceleration, depending upon the force's direction, a bullet is decelerated at a rate proportional to the ratio of the drag force to the mass. For a *standard* projectile, this retardation R is related to a constant A times a power m of the velocity at any instant: thus $R=AV^m$. It has been deduced that the retardation or drag (call it r) for any other projectile differing from the standard only in scale of size is directly proportional to a ratio of the standard projectile's deceleration to a factor known as the ballistic coefficient: thus $r=R/C$. The ballistic coefficient C for a bullet differing in varying degrees of shape from the standard is, in turn, proportional to the ratio of the sectional density to a quality called the *form factor* (commonly known as i): thus $C=(w/d^2)/i$.

The form factor is usually disagreeably hard to calculate from

geometric properties alone, and is therefore inferred from the results of ballistic experimentation. But for *ogival* pointed bullets (ie: a bullet with a point shape defined by a circular arc meeting parallel straight sides at a tangent, or *spitzer*) $i=\sqrt{(16n-4)/7n^2}$, $n=L^2+0.25$, n equals the ratio of arc radius to bullet diameter, L equals the ratio of bullet-head length to diameter (see reference 1). Most bullets are ogival in shape, but serious changes in the form factor are caused by even small flats on the nose (such as hollow points or dents in soft-nose jacketed bullets), and no further use of this mathematical relation will be made.

Since the velocity of a bullet at any time is dependent upon the deceleration, which in turn is dependent on the instantaneous velocity, a differential equation is involved. Since a change in velocity is dependent on the integral of acceleration, the use of the calculus is formidably indicated. Whereas given an initial muzzle velocity one might attempt to tabulate range and velocity for suitably small increments of time, it is easier to tabulate changes in range and time for suitably small decrements in velocity, and avoid the calculus entirely. Summations of these increments of time and range give the total time of flight to a given distance. To do this the values of the constants A and m in the equation $R=AV^m$ must be determined.

Values for the constants A and m were determined by Russian Colonel Mayevski based on data compiled by the German firm of Krupp Armorers in 1881. These figures were converted into English units by Colonel James M Ingalls of the United States Army in the form of a famous tabulation known as the Ingalls Ballistics Tables.

The standard projectile used in the Krupp firings was a spitzer-pointed projectile of 2-caliber radius, flat base, and an overall length of 3 caliber. The shape of small-arms bullets today is similar enough to this standard projectile to allow the Ingalls tables to closely predict their performance. It was found that the factors A and m varied with velocity, but could be taken as constants within suitable limits of velocity and still give accurate results. Thus eight ranges of velocity from 5000 feet per second (fps) to 0 fps, each with its own constants A and m, cover the range of small-arms bullets. The factors A and M in listing 1 are these constants. Also available in the program are the constants to reconstruct the British Ballistic Tables of 1909: these seem to more closely agree with hand-loading data such as is in the *Sierra Bullets Reloading Manual* (for the reloading of cartridges by the shooter).

To reconstruct the Ingalls or British tables, a standard projectile is assumed, with a Krupp-shaped nose, weighing 1 pound, 1 inch in diameter, and with an assigned standard ballistic coefficient of 1 and a form factor of 1 (since $w/d^2=1/1^2=1$). For a small change in velocity $v=U-W$ (U=initial velocity, W=final velocity over a small change in velocities), and average velocity $V=(U+W)/2$, the time for the projectile to decelerate from U to W is $t=v/AV^m$, and the distance over which it travels $s=v/AV^{(m-1)}$. The total time to slow from a given muzzle velocity to any velocity W equals the sum of all these increments of time ($T=\Sigma\ t$) and the total distance $S=\Sigma\ s$.

The computer solves these summations for any bullet, given either its ballistic coefficient or form factor

Listing 1: *BALISTIC, a North Star BASIC ballistic program. The workings of this program and the peculiarities of North Star BASIC are described in the text.*

```
10    REM  ** "BALISTIC"   BY R W JENKS  1979  MOD 9/10/79 **
20     GOSUB 1540\REM (OUTPUT TO TERMINAL)
30     LINE 79
40     DIM C$(50),T(10,2)
50     C1=1\ A4=1\ V=5\ R3=500
60 !  CHR$(27),CHR$(42)
70    REM  ** INPUT PARAMETERS **
80 INPUT "CALCULATE BALLISTIC COEFFICIENT (YES/NO)? ",I$
90     IF I$="YES" THEN F=1 ELSE F=0
100 INPUT "INGALLS OR BRITISH 1909 TABLES? ",I$
110     IF I$(1,4)="INGA" THEN F1=1 ELSE F1=0
120     T3=59+1*F1
130     P1=29.53+.47*F1
140 INPUT1 "WIND SPEED:",W1\ ! "  Miles Per Hour"
150 INPUT1 "CROSS WIND ANGLE:",A1\ ! "  Degrees From Broadside"
160     W2=W1*COS(2*3.1415927*A1/360)*88/60
170     IF I$="W" THEN 460
180 INPUT "CARTRIDGE:",C$
190 INPUT1 "WEIGHT:",W\ ! "  Grains"
200     W=W/7000
210 INPUT1 "CALIBER:",D\ ! "  Inch"
220     IF F THEN 290
230 INPUT "BALLISTIC COEFFICIENT:",C
240     IF C<>0 THEN 260
250 INPUT "FORM FACTOR:",I
260     IF C=0 THEN C=(W/D^2)/I
270     IF I=0 THEN I=(W/D^2)/C
280     C1=C
290 INPUT "NON STANDARD CONDITIONS (YES/NO) ?",I$
300     IF I$<>"YES" THEN 460
310    REM  ** NON STANDARD ATMOSPHERIC CONDITIONS **
320 INPUT1 "TEMPERATURE:",T3\ ! "  Degrees Fahrenheit"
330 INPUT1 "PRESSURE:",P1\ ! "  Inches Mercury"
340 INPUT1 "ALTITUDE:",A2\ ! "  Feet"
350     T4=59-(3.566E-3)*A2+1*F1
360     P2=29.53-(8.581E-4)*A2+(8.602E-9)*A2^2+.47*F1
370     A3=1+(3.073E-5)*A2+(6.371E-10)*A2^2
380     A4=A3*(2-P1/P2)*(T3+459.4)/(T4+459.4)
390     C=C1*A4
400     IF F THEN 430
410 !\! "MODIFIED C:",%5F3,C\!
420     GOTO 440
430     T3=59+1*F1\ P1=29.53+.47*F1\ A2=0
440     I=(W/D^2)/C
450    REM  -- END OF ROUTINE --
460 IF NOT F THEN INPUT "TO 500 OR 1000 YARDS? ",R3
470     R3=R3/500
480 INPUT1 "MUZZLE VELOCITY:",V1\ ! "  Feet Per Second"
490     V2=V1+V\R2=0
500     IF NOT F THEN 560
510 INPUT1 "RANGE:",R1\ ! "  Yards"
520     R1=R1*3
530 INPUT1 "FINAL VELOCITY:",V4\ ! "  Feet Per Second"
540     I=1\ C=1\ GOTO 700
550    REM  ** PRINT DATA **
560 ! " ",C$,
570 ! TAB(50),INT(W*7000+.5)," Grains  ",%#5F3,D," Caliber"
580 ! TAB(25),"BALLISTIC COEFFICIENT:  ",C,"    FORM FACTOR: ",I,%#
590 ! TAB(30),"Based on ",
600 IF F1 THEN ! "INGALLS",\ IF NOT F1 THEN ! "BRITISH 1909",
610 ! " Ballistic Tables"
620 ! " WIND  ",%#5F1,W1," MPH   FROM ",A1," Degrees     CROSSWIND  ",W2," FPS"
630 ! " TEMPERATURE ",T3," Degrees F   PRESSURE ",%5F2,P1,
640 ! " Inches Hg   ALTITUDE ",%#,INT(A2)," Feet"
650 !
660 ! "RANGE  VELOCITY  ENERGY  MAX HEIGHT  DROP  DRIFT   TIME"
670 ! "YARDS   FT/SEC   FT-LBS      IN.       IN.    IN.     SEC."
680 !
690    REM  ** BEGIN TIME AND DISTANCE CALCULATIONS **
700     K=2*V*C
710     V2=V2-2*V
720     IF F1 THEN GOSUB 1350 ELSE GOSUB 1190
730     S1=S\ S=S+K/(A*V2^(M-1))
740     T1=T\ T=T+K/(A*V2^M)
750     IF F AND V2<V4 THEN 790
760     IF NOT F AND S>=R2 THEN 870
770     GOTO 710
780    REM  ** RESULTS OF BC/FF CALCULATION **
790     S=S1+(S-S1)*(V2+V-V4)/(2*V)
800     C=(R1/S)/A4
810     I=(W/D^2)/C
820 !
830 ! "BALLISTIC COEFFICIENT:",%#5F3,C
840 ! "FORM FACTOR:",I,%#
850     C1=C\F=0\ GOTO 1090
860    REM  ** PRINT A ROW OF BALLISTIC DATA **
870     V3=(V2+V)-2*V*(R2-S1)/(S-S1)
880     E=V3^2*W/32.1725/2
890     T2=T1+(T-T1)*(R2-S1)/(S-S1)
900     T(R2/(150*R3),0)=R2/3
910     D1=(110.3+82.7*V3/V1)*T2^2
920     T(R2/(150*R3),1)=D1
930     W3=12*W2*(T2-R2/V1)
```

Listing 1 continued on page 274

Listing 1 continued:

```
940 ! %5I,INT(R2/3+.5),%10I,INT(V3+.5),%8I,INT(E+.5),
950 ! %10F1,48*T2^2,%8F1,D1,%7F1,W3," ",%6F3,T2
960     R2=R2+150*R3
970     IF NOT(NOT F AND R2>1500*R3) THEN 710
980    REM  ** TRAJECTORY TABLE **
990 INPUT1 "SIGHT ON AT:",R4\ ! "  Yards     ",
1000 INPUT1 "SIGHT HEIGHT:",H\ ! "  Inches"
1010     FOR X=0 TO 10
1020     T(X,2)=T(R4/(50*R3),1)*T(X,0)/R4-T(X,1)-H*(R4-T(X,0))/R4
1030     NEXT
1040 ! "RANGE Yards      ",\ FOR X=0 TO 8\ ! %7I,T(X,0),\ NEXT\ !
1050 ! "TRAJECTORY In.   ",\ FOR X=0 TO 8\ ! %7F1,T(X,2),\ NEXT\ !
1060 !
1070    REM  ** RESET FOR ITERATION.  W=NEW WIND INFO, A=NEW AIR INFO,
1080    REM      P=PRINTER, T=TERMINAL **
1090     S=0\ T=0
1100 INPUT I$
1110     IF I$="W" THEN 140
1120     IF I$="A" THEN 320
1130     IF I$="T" THEN GOSUB 1540
1140     IF I$="P" THEN GOSUB 1550
1150     IF I$="P" THEN 1100\ IF I$="T" THEN 1100
1160     GOTO 460
1170    REM  *****  DATA  *****
1180    REM  ** BRITISH 1909 BALLISTIC CONSTANTS **
1190 IF V2>2600 THEN 1330
1200 IF V2>2000 THEN 1320
1210 IF V2>1460 THEN 1310
1220 IF V2>1190 THEN 1300
1230 IF V2>1040 THEN 1290
1240 IF V2>840 THEN 1280
1250 IF V2>0 THEN 1270
1260 END
1270 A=74422E-8\ M=1.6\ RETURN
1280 A=59939E-12\ M=3\ RETURN
1290 A=23385E-22\ M=6.45\ RETURN
1300 A=95408E-12\ M=3\ RETURN
1310 A=59814E-8\ M=1.8\ RETURN
1320 A=58495E-7\ M=1.5\ RETURN
1330 A=15366E-7\ M=1.67\ RETURN
1340    REM  ** INGALLS BALLISTIC CONSTANTS **
1350 IF V2>3600 THEN 1510
1360 IF V2>2600 THEN 1500
1370 IF V2>1800 THEN 1490
1380 IF V2>1370 THEN 1480
1390 IF V2>1230 THEN 1470
1400 IF V2>970 THEN 1460
1410 IF V2>790 THEN 1450
1420 IF V2>0 THEN 1440
1430 END
1440 A=4.6761777E-05\ M=2\ RETURN
1450 A=5.9353046E-08\ M=3\ RETURN
1460 A=6.3368148E-14\ M=5\ RETURN
1470 A=9.5697809E-08\ M=3\ RETURN
1480 A=1.3160125E-04\ M=2\ RETURN
1490 A=1.2479524E-03\ M=1.7\ RETURN
1500 A=4.0648825E-03\ M=1.55\ RETURN
1510 A=4.05E-03\ M=1.551\ RETURN
1520    REM  ** TERMINAL/PRINTER OUTPUT ROUTINES
1530    REM      FOR USE WITH NORTH STAR DOS 3.2 **
1540 FILL 10559,3\ FILL 10567,2\ RETURN
1550 FILL 10559,5\ FILL 10567,4\ RETURN
1560 GOSUB 1550\ END
```

over a suitably small change in velocity of $v = 10$ feet per second, or the program solves for the ballistic coefficient and form factor given muzzle velocity and remaining velocity at any range by calculating the performance of the standard projectile and comparing it with the actual performance of the bullet under consideration. The answers are interpolated for maximum accuracy.

These calculations are relevant for conditions of standard atmospheric density. Other conditions of air temperature, pressure, and water-vapor content may give a density different from standard. Changes in altitude will influence all three factors. These conditions have the effect of modifying the form factor. The factor for a temperature different from standard equals the ratio of the absolute value of the observed temperature to the absolute value of the standard temperature at the desired altitude. (In the English system of units, absolute temperature is measured in degrees Rankine. Degrees Rankine equals 459.4 + degrees Fahrenheit, $t_1^\circ R = 459.4 + t_2^\circ F$.) The factor for a difference in pressure equals 2 minus the ratio of the observed barometric pressure to the standard barometric pressure (again, as would be found at the altitude). The altitude factor is inferred from experimentation, and for this I have used the same factor as in the *Sierra Bullets Reloading Manual* (reference 2). Deviations from standard humidi-

A	Ballistic proportional part constant
A1	Crosswind angle
A2	Altitude above sea level
A3	Altitude factor
A4	Combined atmospheric factor
C	Current ballistic coefficient
C1	Standard ballistic coefficient
D	Bullet diameter (caliber)
D1	Drop
E	Energy
F	Flag to indicate calculation of ballistic coefficient
F1	Flag to indicate choice of constants
H	Sight height above bore
I	Form factor
K	Simplified term for calculations
M	Ballistic exponent constant
P1	Atmospheric pressure
P2	Pressure factor
R1	Final range
R2	Incremental range for tables
R3	Maximum range (in units of 500 yards)
R4	Range at which sights are on
S	Distance
S1	Previous distance
T	Time
T1	Previous time
T2	Interpolated time
T3	Temperature
T4	Temperature factor
V	Incremental velocity
V1	Muzzle velocity
V2	Average interval velocity
V3	Interpolated velocity
V4	Final velocity
W	Bullet weight
W1	Wind speed in mph
W2	Crosswind in fps
W3	Wind drift
X	Loop variable
T( )	Trajectory table array
C$	Cartridge identifier
I$	Response to input request

Table 1: *Table of variables used in the BALISTIC program.*

ty are best ignored. And, indeed, few shooters are likely to hazard whirling a sling psychrometer on the range anyway.

Standard conditions at sea level used for the Ingalls Tables are 30 inches of mercury, 60° F, and air 66% saturated with moisture. This compares with the standard conditions for the tables in the *Sierra Bullets Reloading Manual* of 29.53 inches of mercury, 59° F and 78% relative humidity. The product of these factors with the ballistic coefficient gives an amended ballistic coefficient.

Bullet Path

The trajectory of a bullet is conventionally taken to be the path traversed by the bullet in a vertical plane. This path, in turn, can be measured from various datum lines. When it is measured from the line of the bore and the bore is horizontal, the path is referred to as bullet drop.

In common parlance, the term "trajectory" is assumed to be referenced to the line of sight. This takes into account the offset and angular difference between the line of sight and the bore. As the crosswind effect usually has little or no component affecting the path of the bullet in the vertical plane, it can be treated separately. The combination of the motions of the bullet in the vertical and horizontal planes intersecting at the datum line fully describes its performance along the datum.

If a rifle could be fired on the Earth surrounded by a vacuum, the bullet would begin to fall, and over a time, the distance it falls would exactly equal one-half the gravitational constant times the square of the time of flight. The effect of the atmosphere is to restrict the fall of a bullet. This does not imply that shooting through an atmosphere gives better performance than shooting in a vacuum, because, though the bullet drops less for a given time of flight, it takes longer to reach a given range, and thus the total drop for a given range is greater. A bullet fired in a vacuum would retain its muzzle velocity, as the absence of air implies an absence of anything to impede its progress.

The *British Textbook of Small Arms*, 1929, likens the effect of the air to a simulation of a gravitational constant that decreases with range. Thereby the vacuum equation may be used, but using a different constant— f instead of g. This is approximated by the equation $f = g - 0.429g(M - W)/M$, where W equals the velocity at the given range, and M equals the velocity the bullet would have at the same range had it been fired in a vacuum; for all ranges M would be equal to the muzzle velocity. This equation is only a correlation with the facts and is not meant to actually explain the mechanism of bullet drop under the influence of air. But it is acceptably accurate down to velocities where $W > M/3$ (see reference 1).

To determine an actual trajectory, the curve of the bullet path versus range is tilted up just enough so that the curve crosses a horizontal line (from the muzzle) at the given range where the gun is to shoot on target. This is effectively accomplished for small angles of elevation by subtracting from the drop, at the range, an amount proportional to the product of the bullet drop at the targeted

range times the ratio of any range to the targeted range ($o=d-Dr/R$, where $o=$ modified ordinate relative to the horizontal, $d=$drop at any range, $D=$drop at targeted range, $r=$any range, $R=$targeted range). A table of discrepancies between the path of the bullet and the horizontal is modified for the difference between the angle of the line of sight and the horizontal (crossing at the targeted range). Thus $O=o-h(R-r)/R$, where $O=$ the ordinate from the line of sight, and $h=$ the separation of sight and bore; h usually varies from 0.75 to 2 inches.

For any given target range, the maximum height reached by the bullet above the horizontal while traveling to that range is $H=48T^2$ inches. Maximum height and midrange trajectory are nearly identical over the limits of practical shooting distances.

Crosswind

Though the effect of air resistance on bullet drop is somewhat odd, the effect of a crosswind is downright confusing. One would think that a bullet in a crosswind might do one of three things: it might quickly begin drifting with the wind if it were light relative to its lengthwise sectioned area, or it might resist the wind tenaciously if it were massive relative to this area, or, most likely, it should do a little of both; drifting to the extent that it is light and resisting to the extent that it is massive. In any case its crosspath acceleration should appear to be smooth as its sideways speed approaches that of the wind.

In truth, though, a bullet will drift an amount equal to the product of the component of the wind perpendicular to the axis of the bullet multiplied by the difference between the time the bullet takes to reach any range and the time it would take to reach that range were it fired in a vacuum. This time of travel in a vacuum equals the range divided by the muzzle velocity. It is hard to believe that both a slow-moving bullet and a fast-moving bullet (ie: bullets moving slower or faster than the speed of sound) drift less for the same ranges than bullets moving more nearly at the speed of sound, even though the fast-moving bullet gets to the target sooner and the slow-moving bullet gets there later. A bullet fired at a speed faster than the speed of sound at first accelerates sideways moderately, then accelerates considerably in drift while

Listing 2: *This is a sample run of BALISTIC producing a calculation of bullet parameters. Note that the* Sierra Handbook *(reference 2) also gives the ballistic coefficient as 0.285. Compare the velocities for standard conditions.*

```
         RANGE      0      100      200      300      400      500
      VELOCITY   3800     3405     3045     2713     2405     2117


READY
RUN50

*
CALCULATE BALLISTIC COEFFICIENT (YES/NO)? YES
INGALLS OR BRITISH 1909 TABLES? BRITISH
WIND SPEED:8  Miles Per Hour
CROSS WIND ANGLE:32  Degrees From Broadside
CARTRIDGE:.22/250
WEIGHT:55  Grains
CALIBER:.224  Inch
NON STANDARD CONDITIONS (YES/NO) ?YES
TEMPERATURE:68  Degrees Fahrenheit
PRESSURE:29.00  Inches Mercury
ALTITUDE:2150  Feet
MUZZLE VELOCITY:3800  Feet Per Second
RANGE:400  Yards
FINAL VELOCITY:2460  Feet Per Second

BALLISTIC COEFFICIENT: .285
FORM FACTOR: .550
?
TO 500 OR 1000 YARDS? 500
MUZZLE VELOCITY:3800  Feet Per Second
 .22/250                                               55 Grains    .224 Caliber
                          BALLISTIC COEFFICIENT:    .285     FORM FACTOR:   .550
                               Based on BRITISH 1909 Ballistic Tables
 WIND     8.0 MPH    FROM  32.0 Degrees      CROSSWIND    10.0 FPS
 TEMPERATURE   59.0 Degrees F    PRESSURE 29.53 Inches Hg    ALTITUDE   0 Feet

RANGE  VELOCITY  ENERGY  MAX HEIGHT   DROP   DRIFT    TIME
YARDS   FT/SEC   FT--LBS     IN.       IN.    IN.     SEC.

   0      3800    1763        .0        .0     .0    .000
  50      3601    1583        .1        .3     .1    .041
 100      3409    1419        .3       1.3     .5    .083
 150      3224    1270        .8       3.0    1.2    .129
 200      3046    1133       1.5       5.5    2.2    .176
 250      2875    1009       2.5       8.9    3.6    .227
 300      2710     897       3.8      13.4    5.3    .281
 350      2552     795       5.5      18.9    7.4    .338
 400      2399     703       7.6      25.8    9.9    .399
 450      2250     618      10.3      34.2   12.9    .463
 500      2107     542      13.6      44.2   16.4    .532
SIGHT ON AT:200   Yards    SIGHT HEIGHT:1.5   Inches
RANGE Yards            0      50      100      150      200      250      300      350      400
TRAJECTORY In.      -1.5     -.1       .7       .8      -.0     -1.7     -4.4     -8.2    -13.3

?A
TEMPERATURE:68  Degrees Fahrenheit
PRESSURE:29.00  Inches Mercury
ALTITUDE:2150  Feet
MODIFIED C  .300
TO 500 OR 1000 YARDS? 500
MUZZLE VELOCITY:3800  Feet Per Second
 .22/250                                               55 Grains    .224 Caliber
                          BALLISTIC COEFFICIENT:    .300     FORM FACTOR:   .522
                               Based on BRITISH 1909 Ballistic Tables
 WIND     8.0 MPH    FROM  32.0 Degrees      CROSSWIND    10.0 FPS
 TEMPERATURE   68.0 Degrees F    PRESSURE 29.00 Inches Hg    ALTITUDE   2150 Feet

RANGE  VELOCITY  ENERGY  MAX HEIGHT   DROP   DRIFT    TIME
YARDS   FT/SEC   FT-LBS      IN.       IN.    IN.     SEC.

   0      3800    1763        .0        .0     .0    .000
  50      3611    1592        .1        .3     .1    .040
 100      3428    1435        .3       1.3     .5    .083
 150      3252    1291        .8       3.0    1.2    .128
 200      3082    1160       1.5       5.5    2.1    .175
 250      2918    1039       2.4       8.8    3.4    .225
 300      2760     930       3.7      13.2    5.0    .278
 350      2607     830       5.4      18.7    6.9    .334
 400      2460     739       7.4      25.4    9.3    .393
 450      2317     656      10.0      33.5   12.1    .456
 500      2178     579      13.1      43.2   15.3    .523
SIGHT ON AT:200   Yards    SIGHT HEIGHT:1.5   Inches
RANGE Yards            0      50      100      150      200      250      300      350      400
TRAJECTORY In.      -1.5     -.1       .7       .8       .0     -1.6     -4.3     -8.0    -12.9

?T
```

Circle 192 on inquiry card.

transiting the speed of sound (slowing down in its motion toward the target), and then settles back to drifting at small incremental velocities from there on.

The logic behind the observations is that the amount of deceleration affecting a bullet traveling close to the speed of sound is large (as a measure) due to turbulence. At both higher and lower speeds, the combined effects of base drag, skin friction, and nose drag are changing less over a given range, and so the bullet travels this distance nearer to the time it would take were it able to maintain its initial velocity. Were the bullet able to arrive at a given range in the time it would take if it could maintain its muzzle velocity, this would imply an absence of air resistance, an absence of wind, and thus no drift. This supports the dependence on the time difference.

Also affecting the horizontal path of a bullet is a gyroscopic effect causing the bullet to point away from its initial line of flight. As the bullet falls, additional air resistance appears on the bottom of the bullet. This leads to asymmetrical torques around the center of mass which cause the bullet to attempt to tilt around a horizontal lateral axis, but because the bullet is spinning, the gyroscopic effect resists the turning moment and redirects it by 90°, thus causing the bullet to yaw and veer away from the line of the bore. The effect is minor and only amounts to 6.7 inches at 1000 yards for a 150-grain, full-jacket 30-06 bullet.

The Program

BALISTIC, listing 1, is written in North Star BASIC for use on a North Star Horizon computer and may need modification for use with other BASICs. An exclamation point (!) is North Star BASIC shorthand for PRINT. The backslash (\ ) is the multiple-statement-per-line separator; commas separate print items. Line 60 of the program sends the clear-screen command for a Soroc IQ-120 terminal, an Escape-asterisk (ESC-*) sequence. Lines 1540 and 1550 modify the North Star BASIC disk operating system output routine so as to reconfigure output to either the standard serial port (terminal) or secondary serial port (printer), and thus doing away with the need for device designation parameters in all

PRINT statements. Lines 1540 and 1550 should be replaced with appropriate routines or just RETURNs on all computers where such execution might cause havoc. BALISTIC runs in 5300 bytes, but can be shortened by deleting spaces and remarks, and by merging statements onto fewer lines. BALISTIC may also be shortened by excising the routine for the constants of one or the other ballistic tables.

Operation

The program is self-prompting for the most part, as shown in listing 2. It operates in two major modes: simulating bullet performance based on parametric input or calculating normalized ballistic parameters based on experimental data (after which it returns to the simulation mode). Units are English, and terminology is characteristic of the shooting sports (7000 grains per pound). Pertinent information is repetitively printed so that it is not lost in the shuffle. A suitably placed GOTO statement bypassing these lines saves paper when you are compiling records such as handloading information.

When the computer prompts for the caliber, the bore diameter plus the depth of one groove is expected: the diameter of the bullet is a suitable alternate. If the ballistic coefficient, *C*, is not known, but the form factor, *i*, is known, entering 0 for *C* allows the computer to prompt for *i*. When the computer prompts for the maximum range to which to calculate, any range may be entered, not just 500 or 1000 yards. But when the program asks for the "SIGHT ON RANGE," a range listed in the table must be used (other than 0). The question mark following the trajectory table prompts for an "A", "P", "T", "W", or a carriage return—for new atmospheric data, printer or terminal output, new wind data, or reiterate.

Conclusions

I hope all the major factors that affect bullet performance have been included, so that accurate results are possible. The greatest, though unquantized, limitation is that the ballistic coefficient changes with velocity for projectiles differing from 1 in form factor. The farther from standard this deviation, the less accurately will the calculated results match the real bullet performance, since the standard projectile will be less of a model for the actual bullet. Even so, the calculations tend to match actual performance within 1% for velocity and 2% for bullet path out to 500 yards or more, and compare nicely with published cartridge manufacturers' information and reloading guide data. Do not expect especially accurate results for blunt-nosed bullets or slow-moving boattails, though. But the accuracy is probably consistent with random variations in the actual physical conditions such as spatial variations in wind speed and direction, air temperature and humidity, bullet imperfections and variations in weights, etc. Reduction of published data might indicate a mathematical relationship between bullet geometry and the way the ballistic coefficient changes with velocity, and thus the equations in the program might be modified for more universal simulations.

See the references for other sources and additional information. *Hatcher's Notebook* is extremely interesting reading on a variety of shooting subjects. Other reloading guides are also valuable.

So go ahead, load BALISTIC, and take your computer to the range.■

References

1. Hatcher, Maj Gen Ret Julian S, *Hatcher's Notebook*, Third Edition, The Telegraph Press, Harrisburg PA, 1966, Library of Congress number 62-12654.
2. *Sierra Bullets Reloading Manual*, First Edition, 1971, Sierra Bullets, 10532 S Painter Ave, Santa Fe Springs CA 90670.
3. Walters, Kenneth L, "Crosswind Deflections: a Cast Bullet Anomaly," *Gun Digest*, Thirty-third edition, 1979, DBI Books Inc Northfield IL.

An Interrupt-Driven Real-Time Clock for the TMS 9900

Thomas G Morris Jr
861 St Mary Ave
San Leandro CA 94577

One of the first things many computer enthusiasts feel the need for is a real-time clock for their personal computers.

With many different methods available for the computer to maintain the time of day, I decided that any real-time clock should have a reasonably low software overhead and simple hardware approach.

Processor Overview

One of the 16-bit microprocessors now readily available to computer users is the Texas Instruments TMS 9900.

The TMS 9900 is a 16-bit processor using a memory-to-memory architecture that allows multiple register files (known as workspaces) to reside in memory. A workspace is defined as sixteen contiguous words of memory, addressable as registers R0 thru R15. This method increases programming flexibility and produces a faster interrupt-response time than other processors have; a context switch may be performed without the use of a stack.

Registers

The processor contains three hardware registers. They are:

- program counter (PC)
- status register (ST)
- workspace pointer (WP)

The program counter contains the address of the instruction following the currently executing instruction. The status register contains the current state of the processor (ie: flags and interrupts). The workspace pointer register points to the first word of the current workspace.

Addressing

The TMS 9900 has both word and byte addressing capability. The byte-addressing mode is internal to the processor and references the leftmost byte of a workspace register. There are seven main addressing modes. These are given along with the assembler mnemonics in table 1.

Interrupts

The TMS 9900 utilizes sixteen vectored interrupts. The interrupt vectors are contained in hexadecimal memory locations 00 thru 3C and consist of the interrupt workspace pointer and a pointer to the interrupt code. When an interrupt has been

1. Register	(MOV R0,R1)
2. Register Indirect	(MOV *R0,R1)
3. Register Indirect with Auto-Increment	(MOV *R0+,R1)
4. Direct (Symbolic)	(MOV R0,@Label)
5. Indexed	(MOV R0,@Label(R1))
6. Immediate	(LI R0,>FFFF)
7. Relative	(JMP $+3)

Table 1: *The 7 main addressing modes of the Texas Instruments TMS 9900 16-bit processor, given with assembler- mnemonic representation. Additional addressing modes can be simulated by subroutines called through extended-operation (XOP) instructions.*

About the Author

Thomas G Morris Jr works for General Electric as a minicomputer systems software analyst. His personal computer is a Technico Super Starter system with 32 K bytes of programmable memory, 2 K bytes of programmable read-only memory, and 2 K bytes of read-only memory containing a monitor and disk handler. Peripherals include an 8-inch floppy disk, paper tape reader, a Southwest Technical Products AC-30 cassette unit, and a Texas Instruments 733KSR terminal.

Circle 197 on inquiry card.

SORCERER SOFTWARE

SYSTEM 2 by Richard Swannell, loads into the top of available RAM and becomes an integral part of the BASIC language. All commands are single keystroke. SYSTEM 2 is written in Z80 and provides the following features:

1. **SCREEN EDITOR.** Use the editor to insert, replace, delete or rubout characters in your BASIC program. Watch the line change on the screen! Gone are the days of typing in a whole line to change one character!
2. **FUNCTION KEYS.** SYSTEM 2 allows 12 keys to be programmed to represent one or more characters or up to several lines of text each! After a keyis programmed, by simply hitting key, all the text is sent to the processor just as if you typed it in on the keyboard! Function keys may be used in all modes of operation, including the editor. This feature is handy for lengthy and/or often used commands and may include multiple statements.
3. **RENUMBERING ROUTINE.** With a single keystroke your program is renumbered. Starting line number and increment may be changed.
4. **BASIC BUFFER PROTECTOR.** SYSTEM 2 sends a (CR) when the BASIC BUFFER is full. This prevents BASIC from crashing.
5. **PRINTER DRIVER.** Simply hit CTRL P to direct output to Centronics printer.
6. **RIVIVAL ROUTINE.** If NEW or CLOAD are typed, or RESET is hit by mistake, your program may be recovered. This is a safety device.

OTHER FEATURES

- RUNSTOP stops execution until any other key is hit.
- CLEAR clears screen then sends a (CR). Hit CLEAR to start on 'new page'.
- CTRL characters such as ESC, LF and CLEAR don't return ?SN ERROR.
- RUB doesn't require the SHIFT key to be depressed. This quickens editing.
- Includes a Real Time Random Number Generator.
- Returns automatically to BASIC after TAPE CRC ERROR while CLOADing.
- Suppresses premature CRLF. Normally, if RUB is used extensively while typing in a BASIC line, the cursor will drop down to the next line before reaching the end of the current line. SYSTEM 2 prevents this.
- SYSTEM 2 requires 2K of memory and is available in 8, 16, 32 & 48K versions. **$35.50**

RS232 PRINTER DRIVER. Requires 250 bytes of memory and is relocatable. Suitable for MONITOR, STANDARD BASIC, WORD PROCESSOR PAC & DEVELOPMENT PAC. Stores each character in a buffer then sends the whole line at once, which solves timing problems. **$10.00**

COMBINED SYSTEM 2 & RS232 PRINTER DRIVER. SYSTEM 2 with the RS232 printer driver instead of Centronics printer driver. **$40.00**

LUNA LANDER. Written in Z80 and Basic and requiring 16K. LUNA LANDER uses graphics to the full. Land you craft on the moon in real time. But be careful to land softly, otherwise you will see your LANDER crumple before your very eyes! **$15.00**



SYSTEM SOFTWARE

1 Kent Street, Bicton, 6157 Australia

Program comes on cassette and includes full documentation. Specify size of RAM. Prices in Australian Dollars. Add $2 for overseas airmail.
SORCERER is a trade mark of **EXIDY INC.**

Circle 198 on inquiry card.

LEAPAC SERVICES

MAURO PROAC MP-250 PLOTTER - $695
with L2D Plot package - $795
with L2D & L3P packages - $950

LEAPAC SERVICES

PROAC

MAURO PLOTTER - Uses 11" by 8-1/2" or any length paper. Resolution is 200 steps per inch. 0.005" tracking error. Mauro X-Y vector software with pen control is available for 8080/Z80, 6502, & 6800 micro-processors. Requires 5 bits of a parallel output port. APPLE, TRS-80, and RS232 Interfaces are available as I/O Options.

LEAPAC SOFTWARE - Supports complete 2D & perspective plotting, including ASCII and curve generation. Available as relative linking libraries (L80) for MICROSOFT compatible software products, FORTRAN-80, COBOL-80, COMPILER BASIC, and MACRO-80 in CP/M compatible files on 8" IBM-3740 disks or 5-1/4" NORTHSTAR formatted disks.

L2D - X-Y plot package. Contains over 20 entries, including CALCOMP compatible calls such as PLOT and WHERE.

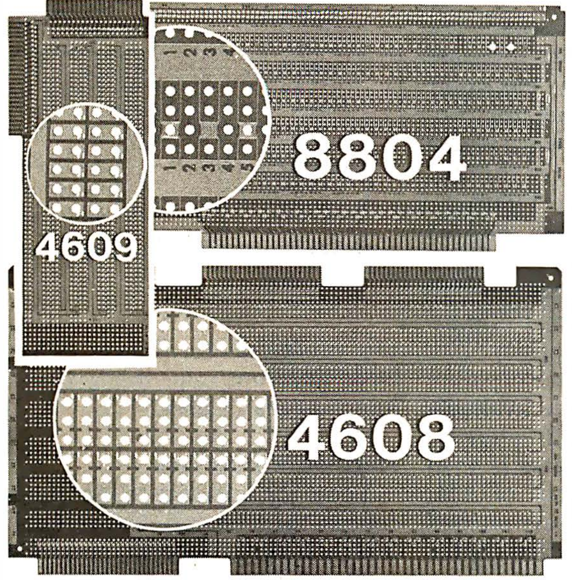
L3P - Perspective plot package. Contains over 70 entries. Capable of ZOOMING, FLY-BYS, ANIMATION and much more. (See self portrait above).

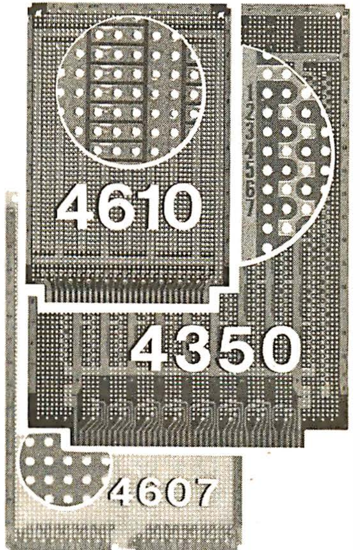
LEAPAC SERVICES (916) 381-1717
8245 MEDITERRANEAN WAY SACRAMENTO CA 95826
DEALER INQUIRIES ARE INVITED

CP/M is a registered trade mark of Digital Research, Inc.
MICROSOFT is a trade mark of MICROSOFT, Inc.CA
CALCOMP is a trade mark of California Computer Products, Inc.

BUILD YOUR COMPUTER BREADBOARDS & INTERFACES FASTER AND EASIER WITH NEW VECTOR PLUGBORDS

EASY TO USE! COST EFFECTIVE! CLEAN HOLES!





4610 Series - For STD-BUS-WW, solderable and unpatterned models

4608 Series - For Intel/National SBC/BLC 80-WW/solderable, or unpatterned

8804 Series - For S100 - 5 models available

4607 - For DEC LSI 11/PDP8-11, Heath H-11

4609 - For Apple II, SuperKim, Pet Commodore with Expandamem

4350 - For TI 980 Computer



Vector Electronic Company INCORPORATED

12460 Gladstone Ave., Sylmar, CA 91342 (213) 365-9661 TWX (910) 496-1539

Available through Distributors or Factory Direct if not available locally. 74801

Circle 199 on inquiry card.

Figure 1: *Schematic diagram of the circuit for the real-time clock, with enable, reset, and disable states shown. IC1 (a 7490) is wired in a divide-by-6 configuration.*

Number	Type	+5 V	GND
IC1	7490	5	10
IC2	7490	5	10
IC3	7404	14	7
IC4	7474	14	7

detected, all lower-priority interrupts are inhibited until the current interrupt has been dismissed. The only exception to this is the reset function (which has a priority level of 0).

When an interrupt has been detected, a context switch is performed by fetching the new workspace pointer and program counter values from the appropriate interrupt vector locations. During this same time period, the old workspace pointer, program counter and status registers are saved in the new workspace registers R13, R14, and R15 respectively. When the interrupt has been dismissed by the interrupt subroutine, the processor is returned to its preinterrupt state by issuing a return (RTWP) instruction.

Input/Output

The TMS 9900 employs a direct input/output (I/O) interface method which is designated the communication register unit (CRU). The communication register unit provides for a maximum of 4096 bits of I/O capability. From 1 to 16 bits may be set or reset at a time; additionally, single bits may be tested for their value.

Clock Hardware

The heart of the clock assembly is a crystal-controlled, 60 Hz time-base generator sold by many electronic firms. The time-base generator produces an accurate square wave with a 50% duty cycle, which is fed through IC3, a 7404 inverter (see figure 1). This buffered signal is then directed to IC1 (7490), which is set up as a divide-by-6 counter. The resulting 10 Hz signal is then divided by IC2, producing the final 1 Hz frequency.

The 10 Hz and 1 Hz frequencies are buffered by IC3 and made available for use as the minimum interrupt rate. One of the three rates is then directed to the clock input of IC4, which produces the necessary latched output. IC4 (7474 dual-D flip-flop) is needed to guarantee that an interrupt will not be missed, regardless of the level chosen. The exception: if a higher-priority interrupt monopolizes the processor for longer than the basic interrupt rate, the low-priority interrupt may suffer.

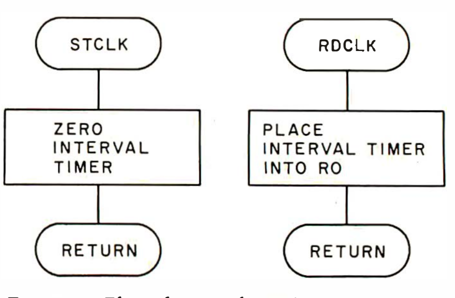


Figure 2: *Flowcharts of routines to operate interval timer.*

Hardware Interface

The clock interface to the computer consists of a simple 2-wire hookup. One wire from the communication register unit port is connected to pin 1 of IC4, clear (CLR), via two sections of the 7404 inverter IC3. This connection provides both the reset and the

FOR SERIOUS USERS
OF 8080, 8085, OR Z80 COMPUTERS

PRINTER WIZARD — Now add powerful capabilities to your printer. Free your computer for use while simultaneously printing backlogged output on a first-in-first-out basis. Transparent operation without noticable slowing of the computer. Allows continuous computer and printer operation on programs having sporadic output. Will backlog up to 100 pages when used with a disk system. Adds optional automatic paging with numbers, adjustable margins on 4 sides, indented overflow lines. Occupies less than 2½ K.

	EX80M103	$45.00
Documentation only	EX80M103D	$ 7.50

DISASSEMBLER — Disassemble machine code into standard source language. Modify or relocate existing programs such as DOS or BASIC using your existing assembler (not included). Disassembles any 8080, 8085, or Z80 code, including embedded data blocks and "trick" codes. Generates symbol and label tables.

	EX80M217	$75.00
Documentation only	EX80M217D	$12.50

ALL EXCOM products are fully supported and warranted indefinitely against original defects. Available on single or double density NORTHSTAR 5¼" diskettes, 300 or 1200 baud cassettes (specify). Washington residents add 5.3% tax.

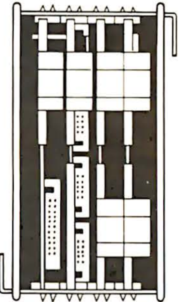


P.O. Box 1802 Bellevue, Washington 98009 U.S.A.
Telephone (206) 641-6577

DEC LSI-11 Components

Dependable service at discount prices

Domestic and Export



Mini Computer Suppliers, Inc.

25 Chatham Rd., Summit, N.J. 07901
Since 1973
(201) 277-6150 Telex 13-6476

PROFESSIONAL



HALF A MILLION TAX RETURNS CAN'T BE WRONG!
(OR THEY HAD BETTER NOT BE)

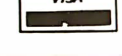
INCOME TAX SYSTEM
FOR TRS-80* MODEL I OR II

Our system, which prepared 500,000 1979 returns, features the following:

1. Full interactive user control, **in tax-form language only,** line by line.
2. Screen display of full 1040 and all schedules, prior to printout.
3. Change of a single amount item automatically changes and re-computes entire return.
4. All printout formats IRS and state approved.
5. Stores Preparer's Identification for automatic printing at bottom of page 2.
6. Built-in Validation Check tests entire system, hardware and software.
7. Special Printer Adjustment routines, Line Length, etc.
8. Selection of closed or open output formats—for standard Form 1040 or open name-box types.
9. **Software control of text position on page.** Makes forms-alignment simple. Permits use with non-adjustable printers.
10. Fills in pre-printed Forms or you can use overlays. Your choice.
11. Automatically computes: Tax - SDI Overpayment - Wages Total from W-2's - Earned Income Credit - Income Averaging - Maximum/Minimum Tax - Least Tax Method - All Percentage of Income Limitations - All Fixed Limitations - many, many more.
12. Full support through the tax season—no charge.
13. Inexpensive yearly updates in accordance with tax-law changes.
14. Modular construction—lets you order only the type and size system you need.

PRICING STARTS AT $189.95 (1040 & SCHEDULE A)
25-Page Descriptive Manual $7.50 (Refunded on Order)
Minimum System Required: Model 1, 32K, 1 Disk Drive

*TRS-80 is a trademark of Tandy Corp.



CONTRACT SERVICES ASSOCIATES
706 SOUTH EUCLID • ANAHEIM, CA 92802 • TELEPHONE (714) 635-4055
★ ★ ★ ★ **20 Years of Service** ★ ★ ★ ★



disable signal to IC4. By momentarily bringing this line low, the current interrupt is dismissed, and further interrupts are enabled. However, if this line is *held* low, all clock interrupts are inhibited until pin 1 of IC4 is once again a logic 1. The other connection is made between pin 6 of IC4 ($\overline{Q}$) and one of the interrupt inputs of the computer, line 1 in this case. This line signals the processor that an interrupt has been requested by an external device, and is active low.

Software

The software necessary to drive the real-time clock is shown in listing 1. To set the time of day and enable the

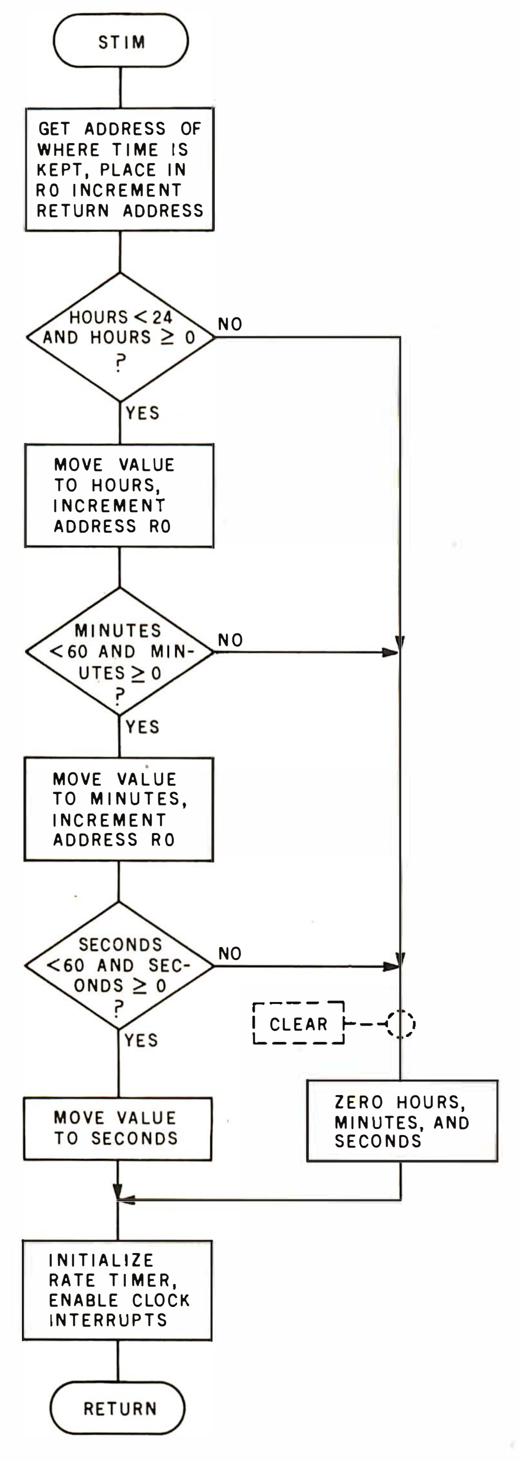


Figure 3: *Flowchart of procedure that sets the clock.*

Circle 203 on inquiry card.

Circle 204 on inquiry card.

INTRODUCING

MAPS

MULTIPLE APPLICATION PROCESSING SYSTEMS

MP/M™ USERS GROUP

Digiac Corporation, a major manufacturer and supplier of automated Educational Training Systems, is proud to announce the formation of **MAPS**, a **National MP/M Users Group** which will provide all MP/M users with a vehicle to exploit MP/M's benefits.

MP/M SUPPORT PRODUCTS

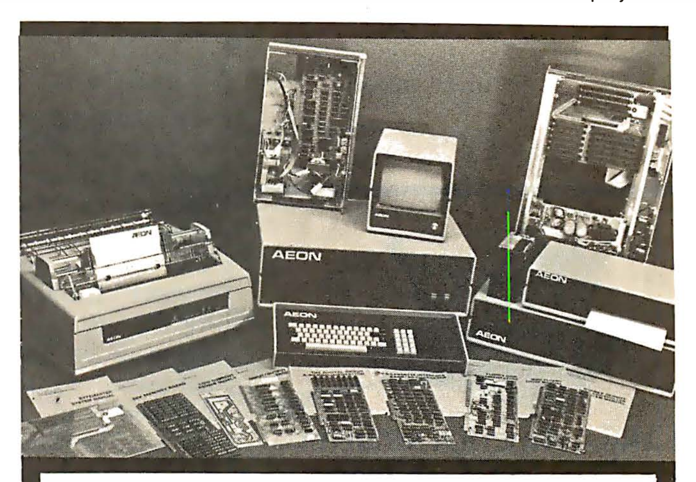
Digiac is supporting MP/M with a series of exclusive S100 products:

- ***Universal MP/M Support Module***
- ***MP/M XIOS Configurations for popular Disk Systems***
- ***MP/M Multibank Memory Module***
- ***CT-80 Multi-Workstation System***

For Additional Information:
Contact Lorraine Keckeisen
MAPS
Commercial Products Div.
DIGIAC CORPORATION
175 Engineers Road
Smithtown, New York 11787
Phone (516) 273-8600



MP/M is a trademark of the Digital Research Corporation



DIGITAL GROUP products are available through AEON Electronics in Denver, Colorado. We carry the complete line of cabinets, printers (Spinwriter & B-Printers), Disks (Shugart), Single & Double Density Controller Cards, Memory Cards, Z-80ACPU 2.5/6Mhz, Communications Card (for terminals & Modems), and Peripheral Boards. All items are from stock.

Bare Communications Card	Comm 4 Pcc	$65.00
32k Static Mem. Board/Sockets, Decoding IC's	Mem 320	$85.00
I/O Card/4 Port in & out	IO-F	$50.00
Double Density Bare Card & Doc	BDD	$95.00
D.G. Dress Mainframe Cabinet/metal only	CB	$85.00
D.G. Dress Cabinet/metal plus Electronic Hardware	CB-CPU	$185.00
D.G. Disk Cabinet/In Stock!!	DSSCB-2	$165.00

ÆEON Manufacture of Digital Group Computers
1855 S. Pearl Denver, Colorado 80210
Phone Orders 303-777-AEON

THE CONFIGURABLE BUSINESS SYSTEM™

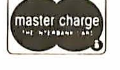
THE ONLY COMPLETE APPLICATION DEVELOPMENT SYSTEM

- No Programming Experience Necessary
- User Definable Records Up To 2K Bytes
- Powerful Report Generating Capabilities
- Built-in, Self-reorganizing ISAM File Structure
- Interactive and Batch Information Processing
- Packed Fields For Efficient Disk Utilization
- System Completely Menu Driven
- Fast Execution - All Programs in 8080/Z80 Machine Code
- Easily Configured to Your CRT
- Field Proven
- Comprehensive Users Guide
- Supplied On 2-8″ CP/M* Compatible Disks

DISKS AND MANUAL $295.00
MANUAL ALONE . . . $ 40.00

DYNAMIC
MICROPROCESSOR
ASSOCIATES

Dealer Inquiries Invited



Phone Orders Accepted
N.Y. Residents Add 7% Sales Tax

36 Pinewood Drive
Commack, N.Y. 11725
(516) 543-6006

***CP/M is a Trademark of Digital Research Corp.**

Circle 205 on inquiry card.

clock hardware, a call is made to the entry point STIM. This call instruction is followed in memory by the address of the memory location where the time of day may be found. This address pointer is placed into register R0 and the return address set by the first line of STIM code. The value to be used for hours is then compared to the maximum value allowed (eg: 24 for a 24-hour clock). The same sequence of events occurs for both the minutes and seconds values. If the number to be used is greater than the maximum allowed or is negative, no further testing is done. Instead, the clock is cleared, the hardware is enabled, and a return is made to the calling routine. The calling routine must then set the interrupt mask to allow interrupts at the chosen level.

To obtain the time of day, a call to the GTIM routine is made. The call instruction is followed by the address of the memory location where the time will be stored.

To access the interval timer, the entry points of STCLK and RDCLK are used. STCLK will reset the timer to 0, and RDCLK will place the current value of the interval timer into the caller's R0.

When the clock hardware generates an interrupt, control is transferred to

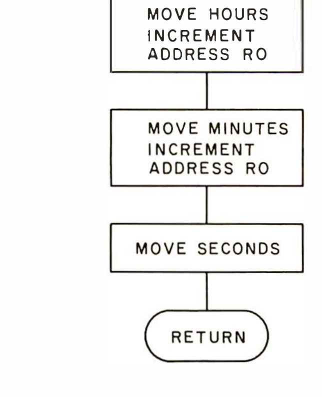


Figure 4: *Flowchart of routine that reads the clock.*

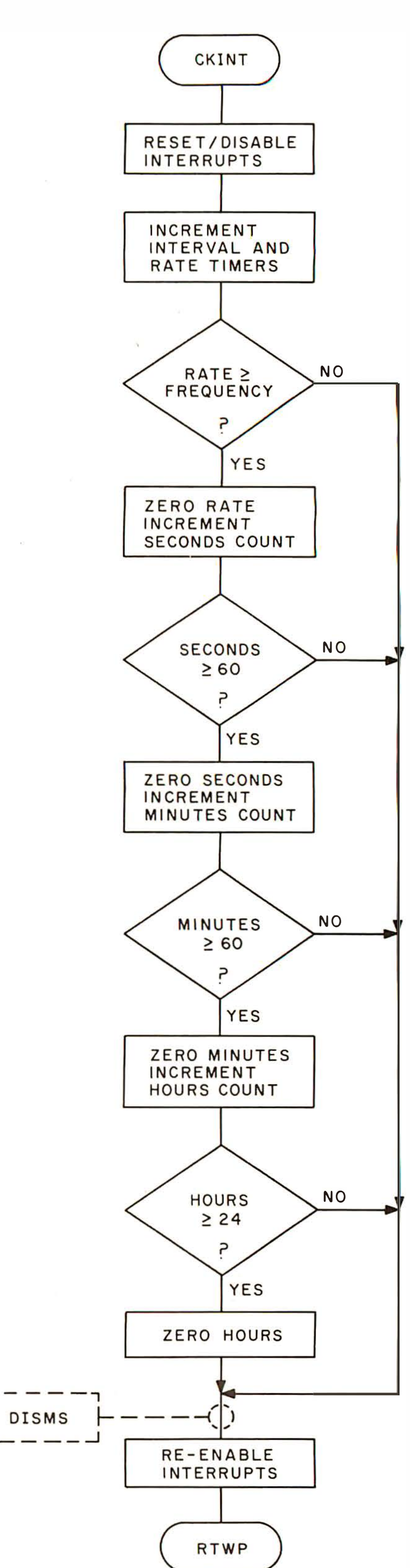


Figure 5: *Flowchart of procedure for dealing with a clock interrupt.*

the entry point CKINT. The interrupt is then reset, and further clock interrupts are inhibited by holding the clock line of the communication register unit low. Next, the interval timer is incremented, as is the rate counter. The rate counter is then compared to the basic clock frequency. If the result of the comparison is less then 0, interrupts are reenabled and the interrupted program resumed. If the result is greater than or equal to 0, the rate counter is reset to 0 and the seconds counter is incremented. The same process that was used for the rate counter is then applied to the seconds, minutes, and hours counters. Lastly, interrupts are reenabled and the interrupted program resumed.

Conclusion

The method presented in this article will allow users a flexible and inexpensive way to maintain the time of day on their personal computer with low software overhead. ■

Listing 1: *Routines that keep time using the real-time clock, written in assembler for the 9900 microprocessor.*

```
                  ************************************************************
                  *
                  *   THIS IS A REAL TIME CLOCK DRIVER PROGRAM FOR THE
                  *   TEXAS INSTRUMENTS TMS9900 MICROPROCESSOR.
                  *   WRITTEN BY: TOM G. MORRIS
                  *               861 ST. MARY AVE
                  *               SAN LEANDRO, CA 94577
                  *
                  *   TO ESTABLISH THE CORRECT TIME OF DAY, ISSUE
                  *   A CALL TO STIM. E.G.    BL   @STIM
                  *                           DATA TOD
                  *
                  *   WHERE TOD POINTS TO AN OUTLINE LIST THAT
                  *   CONTAINS THE TIME OF DAY IN THE FORMAT
                  *   TOD      HOURS
                  *   TOD+1    MINUTES
                  *   TOD+2    SECONDS
                  *
                  *   IF ANY OF THE VALUES ARE INVALID, THE TIME IS
                  *   SET TO MIDNIGHT (00:00:00).
                  *
                  *   TO OBTAIN THE CORRECT TIME OF DAY, ISSUE
                  *   A CALL TO GTIM. E.G.    BL   @GTIM
                  *                           DATA TOD
                  *
                  *   WHERE TOD POINTS TO AN OUTLINE LIST WHERE THE
                  *   CORRECT TIME OF DAY WILL BE STORED. SEE ABOVE.
                  *
                  *   ALSO AVAILABLE TO THE USER IS AN INTERVAL TIMER
                  *   THAT INCREMENTS AT THE INTERRUPT RATE, AND
                  *   IS RESET BY A CALL TO STCLK. E.G.    BL @STCLK
                  *
                  *   TO READ THE INTERVAL TIMER, ISSUE A CALL TO
                  *   RDCLK. E.G.    BL @RDCLK
                  *
                  *   THE CURRENT VALUE OF THE TIMER WILL BE RETURNED
                  *   IN THE USERS R0.
                  *
                  ************************************************************
                  *
                         TITL 'REAL TIME CLOCK DRIVER'
0000              RTC    IDT
                  *
                  *   DEFINE INTERRUPT VECTORS
                  *
0004                     AORG >0004
0004  0000               DATA RTCWS             ;WORKSPACE POINTER
0006  0074               DATA CKINT             ;INTERRUPT HANDLER
                  *
                  *   DEFINE LINKING & REGISTERS
                  *
0000                     RORG *
0000                     DREG
```

Listing 1 continued on page 292

```
                    *
                    *  DEFINE ENTRY POINTS
                    *
                          DEF  STCLK,RDCLK,STIM
                          DEF  GTIM,CKINT

                    *
                    *  THE FOLLOWING PARAMETERS WILL BE MAINTAINED
                    *  IN THE RTC WORKSPACE AREA (DEDICATED)
                    *
0000                RTCWS  BSS  4                ;RTC WORKSPACE (NEXT 32 LOCS)
0004                RATE   BSS  2                ;INTERNAL TIMER
0006                SECS   BSS  2                ;SECONDS
0008                MINS   BSS  2                ;MINUTES
000A                HRS    BSS  2                ;HOURS
000C                TIMER  BSS  2                ;INTERVAL TIMER
000E 003C           SIXTY  DATA 60               ;MINUTES/SECONDS CHECK
0010 0018           TFOUR  DATA 24               ;HOURS CHECK
0012 0001           HERTZ  DATA 1                ;SET TO INT. RATE (1,10,60)
0014                       BSS  4                ;R10-R11
0018 0000                  DATA 0                ;R12 CRU BASE
001A                       BSS  6                ;R13-R15
                    *
                    *  THE FOLLOWING EQUIVALENCES ARE USED
                    *  SINCE THE INTERRUPT HANDLING WORKSPACE
                    *  OVERLAYS THE VARIABLE STORAGE AREA
                    *
0002                XRATE  EQU  R2               ;INTERNAL TIMER
0003                XSECS  EQU  R3               ;SECONDS
0004                XMINS  EQU  R4               ;MINUTES
0005                XHRS   EQU  R5               ;HOURS
0006                XTIMER EQU  R6               ;INTERVAL TIMER
0007                XSIXTY EQU  R7               ;CLOCK CONSTANTS
0008                XTFOUR EQU  R8
0009                XHERTZ EQU  R9               ;INTERRUPT FREQUENCY
000F                CLOCK  EQU  15               ;CLOCK CRU OFFSET
                    *
                    *
                    *
                    *  STCLK: RESET THE INTERVAL TIMER TO ZERO
                    *
0020                STCLK  EQU  $
0020 04E0 000C             CLR  @TIMER           ;CLEAR TIMER
0024 045B                  B    *R11             ;RETURN TO CALLER
                    *
                    *
                    *
                    *  RDCLK: RETURN TIMER VALUE TO CALLER IN R0
                    *
0026                RDCLK  EQU  $
0026 C020 000C             MOV  @TIMER,R0        ;PLACE TIMER INTO R0
002A 045B                  B    *R11             ;RETURN TO CALLER
                    *
                    *
                    *
                    *  GTIM: GET THE TIME OF DAY
                    *
002C                GTIM   EQU  $
002C C03B                  MOV  *R11+,R0         ;GET ADDR PNTR,RETURN ADDR
002E CC20 000A             MOV  @HRS,*R0+        ;STORE HOURS
0032 CC20 0008             MOV  @MINS,*R0+       ;STORE MINUTES
0036 C420 0006             MOV  @SECS,*R0        ;STORE SECONDS
003A 045B                  B    *R11             ;RETURN TO CALLER
                    *
                    *
                    *  STIM: SET THE TIME OF DAY
                    *        ALSO, ENABLE THE REAL
```

Listing 1 continued on page 294

Listing 1 continued:

```
                    *       TIME CLOCK.
                    *
003C                STIM   EQU   $
003C C03B                  MOV   *R11+,R0           ;GET ADDR PNTR,RETURN ADDR
003E 8810 0010             C     *R0,@TFOUR         ;CHECK HOURS
0042 1411                  JHE   CLEAR              ;INVALID, CLEAR CLOCK
0044 C830 000A             MOV   *R0+,@HRS          ;SET THE HOURS
0048 8810 000E             C     *R0,@SIXTY         ;CHECK MINUTES
004C 140C                  JHE   CLEAR              ;INVALID, CLEAR CLOCK
004E C830 0008             MOV   *R0+,@MINS         ;SET THE MINUTES
0052 8810 000E             C     *R0,@SIXTY         ;CHECK SECONDS
0056 1407                  JHE   CLEAR              ;INVALID, CLEAR CLOCK
0058 C810 0006             MOV   *R0,@SECS          ;SET THE SECONDS
005C                RTRN   EQU   $
005C 04CC                  CLR   R12                ;PRESET CRU BASE
005E 04E0 0004             CLR   @RATE              ;INITIALIZE RATE
0062 1D0F                  SBO   CLOCK              ;ENABLE REAL TIME CLOCK
0064 045B                  B     *R11               ;RETURN TO CALLER
0066                CLEAR  EQU   $
0066 04E0 000A             CLR   @HRS               ;CLEAR OUT THE CLOCK
006A 04E0 0008             CLR   @MINS
006E 04E0 0006             CLR   @SECS
0072 10F4                  JMP   RTRN               ;ENABLE CLOCK, RETURN
                    *
                    *  THIS IS THE MAIN INTERRUPT HANDLING SECTION.
                    *  HERE THE TIME OF DAY IS KEPT, ALONG WITH THE
                    *  INTERVAL TIMER.
                    *
0074                CKINT  EQU   $
0074 1E0F                  SBZ   CLOCK              ;DISABLE/RESET
0076 0586                  INC   XTIMER             ;UPDATE TIMER
0078 0582                  INC   XRATE              ;INCREMENT INTERVAL
007A 8242                  C     XRATE,XHERTZ       ;CHECK AGAINST FREQ.
007C 110D                  JLT   DISMS              ;DISMISS INT
007E 04C2                  CLR   XRATE              ;RESET RATE
0080 0583                  INC   XSECS              ;SECONDS COUNT
0082 81C3                  C     XSECS,XSIXTY
0084 1109                  JLT   DISMS
0086 04C3                  CLR   XSECS              ;RESET SECONDS
0088 0584                  INC   XMINS              ;MINUTES COUNT
008A 81C4                  C     XMINS,XSIXTY
008C 1105                  JLT   DISMS
008E 04C4                  CLR   XMINS              ;RESET MINUTES
0090 0585                  INC   XHRS               ;HOURS COUNT
0092 8205                  C     XHRS,XTFOUR
0094 1101                  JLT   DISMS
0096 04C5                  CLR   XHRS               ;RESET HOURS
0098                DISMS  EQU   $
0098 1D0F                  SBO   CLOCK              ;ENABLE INTERRUPTS
009A 0380                  RTWP                     ;RETURN TO INT. LOC.
                    *
009C                       END


 0074 CKINT   0066 CLEAR   000F CLOCK   0098 DISMS  *002C GTIM
*0012 HERTZ   000A HRS     0008 MINS    0000 R0     *0001 R1
*000A R10     000B R11     000C R12    *000D R13    *000E R14
*000F R15     0002 R2      0003 R3      0004 R4      0005 R5
 0006 R6      0007 R7      0008 R8      0009 R9      0004 RATE
*0026 RDCLK  *0000 RTC     0000 RTCWS   005C RTRN    0006 SECS
 000E SIXTY  *0020 STCLK  *003C STIM    0010 TFOUR   000C TIMER
 0009 XHERTZ  0005 XHRS    0004 XMINS   0002 XRATE   0003 XSECS
 0007 XSIXTY  0008 XTFOUR  0006 XTIMER
OUTPUT READY?
```

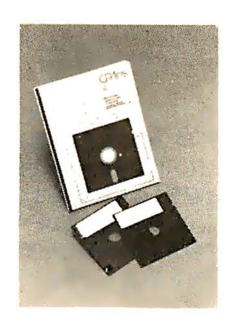
Listing 1 continued on page 296

Circle 213 on inquiry card.



Circle 214 on inquiry card.

WE CAN'T WAIT FOR EVERYONE ELSE TO CATCH UP!



While other software dealers only promise **TAX SOFTWARE** in the future - **CPAids** has it **NOW!** And we've even added more schedules!

MASTER TAX PACKAGE:
Schedules - A, B, C, D, E, F, G, R/RP, SE, TC, ES.
Forms - 2106, 2119, 2210, 3468, 3903, 2441, 4625, 4726, 4797, 4792, 5695, 6521.
Available on North Star and most CP/M compatable 8" soft sector computers.

Trust CPAids, the people who started it all. Like you, we just couldn't wait any longer.

Call Toll Free
800-321-2430



1640 Franklin Ave. • Kent, Ohio 44240



SOFTWARE CONCEPTS



A NEW CONCEPT IN APPLE][* SOFTWARE

Finally, a company specializing in software for the APPLE][or][Plus and only **APPLES**! All your software shopping can now be done under **ONE ROOF** at **TREMENDOUS SAVINGS**! Because we sell software and only software, we receive discounts from **ALL** major Suppliers, such as:

HAYDEN
PROGRAMMA
CREATIVE COMPUTING
MICROSOFT
PERSONAL SOFTWARE
and MANY OTHERS

and **WE CAN PASS THESE SAVINGS ONTO YOU, the APPLE USER!**

If you are tired of page thumbing looking for APPLE programs, and want the best prices on **ALL** programs written for the APPLE, send for our **FREE** 40-page catalog and a $1 coupon good towards your first order or call us for our price on any APPLE program written and order by phone. M/C, VISA, BankAmericard accepted.

IF WE HAVEN'T GOT IT, IT HASN'T BEEN WRITTEN!!

**Trademark of APPLE Computers Inc.*

Software Concepts
948 Danvers Ave., Westerville, OH 43081
(614) 882-8007

Hours:
10AM-9PM Weekdays
12Noon-5PM Saturdays
Closed Sundays

NEW PRODUCTS

Lo-Res Graphics Pads	$ 1.75/ea.
Verbatim 5" Diskettes	$ 2.65/ea.(Quan 1)
CASTLE ADVENTURE!	$17.95/disk

Circle 215 on inquiry card.

Listing 1 continued:

```
00000RTC      A000090004C0000C0074A000EB003CB0018B0001A0018B0000A00207F1F6F
B04E0C000CB045BBC020C000CB045BBC03BBCC20C000ABCC20C0008BC420C00067F170F
B045BBC03BB8810C0010B1411BC830C000AB8810C000EB140CBC830C0008B88107F1ABF
C000EB1407BC810C0006B04CCB04E0C0004B1D0FB045BB04E0C000AB04E0C00087F18FF
B04E0C0006B10F4B1E0FB0586B0582B8242B110DB04C2B0583B81C3B1109B04C37F193F
B0584B81C4B1105B04C4B0585B8205B1101B04C5B1D0FB038050074CKINT 5002CGTIM   7EFD8F
50026RDCLK 50020STCLK 5003CSTIM   0009C          7F610F
:

EDIT/ASM/LOAD?
```

Listing 2: *A program to demonstrate the use of the real-time clock.*

```
                    ***************************************************
                    *
                    *   DEMONSTRATION PROGRAM FOR THE
                    *   TIME OF DAY CLOCK ROUTINE
                    *
                    *   WRITTEN BY: TOM G. MORRIS
                    *               861 ST. MARY AVE
                    *               SAN LEANDRO, CA 94577
                    *
                    *   DEMONSTRATES THE USAGE
                    *   OF THE RTC SOFTWARE
                    *
                    ***************************************************
                    *
                          TITL 'RTC DEMONSTRATION'
0000                EXIDT IDT
                    *
                    *   DEFINE LINKING & REGISTERS
                    *
0000                      RORG *
0000                      DREG
                    *
                    *   DEFINE EXTERNALS & ENTRY
                    *
                          REF  STCLK,RDCLK
                          REF  STIM,GTIM
                          REF  RTC,DIO
                    *
                          DEF  EXMPL
                    *
2D48                DIN   DXOP 5              ;DECIMAL INPUT
2D88                DOUT  DXOP 6              ;DECIMAL OUTPUT
                    *
                    *   STORAGE FOR TIME OF DAY
                    *
0000                HRS   BSS  2              ;HOURS
0002                MINS  BSS  2              ;MINUTES
0004                SECS  BSS  2              ;SECONDS
0006                TICKS BSS  2              ;INTERVAL TIMER
                    *
                    *   TEXT STORAGE
                    *
0008 0D0A 00        CRLF  BYTE >0D,>0A,0
000B 0D0A           MESS0 BYTE >0D,>0A
000D 454E 5445            TEXT 'ENTER TIME OF DAY (HH:MM:SS) ?'
0011 5220 5449
0015 4D45 204F
0019 4620 4441
001D 5920 2848
0021 483A 4D4D
```

Listing 2 continued on page 298

Circle 216 on inquiry card.

Circle 217 on inquiry card.

ANNOUNCING: *NEW!*

MICROSTAT

A complete statistics package for business, scientific, education and research work. No other package has the features of MICROSTAT. For example:

- **File oriented with COMPLETE editing**
- **A Data Management Subsystem for editing, sorting, ranking, lagging, data file transfers PLUS 11 data transformations (e.g., linear, reciprocal, exponential, etc.)** • **Frequency distributions** • **Simple and multiple regression** • **Time series (including exponential smoothing)** • **11 Non-parametric tests** • **Crosstabs/Chi-square**
- **Factorials (up to 1,000,000!), permutations, combinations**
- **8 Probability distributions** • **Scatterplots**
- **Hypothesis test (Mean, proportion)** • **ANOVA (one and two-way)** • **Correlation** • **Plus many other unique features**

Users manual: $10.00 (credited towards purchase) and includes sample data and printouts. Uses NORTH STAR BASIC 32K of memory, one or two disk drives (2 recommended). Printer optional. Price: $200.00



ECOSOFT
P.O. Box 68602
Indianapolis, IN 46268

Phone orders:
(317) 253-6828

FLOPPY DISK FACTORY DIRECT FLOPPY DISK FACTORY DIRECT FLOPPY DISK FACTORY DIRECT FLOPPY DISK FACTORY DIRECT FLOPPY DISK FACTORY DIRECT FLOPPY DISK FACTORY DIRECT FLOPPY DISK FACTORY DIRECT FLOPPY DISK FACTORY DIRECT FLOPPY DISK F

- Buy factory direct from the manufacturer of floppy disks sold exclusively under other well-known brand names.
- Save distribution costs on reversible 5.25" floppy disks, which are 100% certified for 40 track, dual side, double density and all other standard applications.
- **50%** savings on 5.25" floppy disks with new factory-direct 2.2 megabyte capacity **"Diskit"**.
- Factory-direct **"Diskit"**, includes twelve floppy disks and accessories, plus a head cleaner disk and solution packaged in a bookcase binder for easy access, handling and storage. **"Diskit"** complete for the introductory price of only $49.50 plus $2.50 freight and handling. Normal price $59.50. **Order now and save $10.00** (CA residents add 6½% sales tax).
- Available in hard and soft sector configurations; when ordering indicate number of sectors — 1, 10 or 16.
- Send check or money order to:

Factory Direct
P.O. Box 60759
Sunnyvale, CA 94088
For VISA or MasterCard call toll-free
(800) 824-7888
In Calif. (800) 852-7777
In Alaska & Hawaii (800) 824-7919
Ask for Operator 98

Omikron's Mapper + NEWDOS/80
8" Drives for the TRS-80

NEWDOS/80 is Apparat's latest upgrade to NEWDOS. Features include variable length records, chaining, and drivers specifically configured for Omikron's MAPPER II. $150.

MAPPER II adapts the TRS-80 to run both 5" and 8" drives. With NEWDOS/80, storage is increased to 300K per 8" drive. $99 plus $10 per cable connector.

MAPPER I adapts the TRS-80 to run the vast library of CP/M software as well as the TRS-80 software. All Lifeboat Software may be ordered for the MAPPER I. All MAPPER I CP/M software is compatible with the CP/M for the Model II. With MAPPER II and 8" drives, the Model I becomes disk compatible with the Model II.

Standard features include lower case support, serial and parallel printer drivers, and an addressable cursor. MAPPER I is supplied with complete utilities including a memory test, a disk test, a copy program, and a proprietary program for converting TRS-DOS files to CP/M files. $199.

WORD PROCESSING—MAPPER I supports professional word processors like the Magic Wand and Word Star (see reviews in June 80 Kilobaud). Omikron's implementation includes a blinking cursor, auto repeat, shift lock, debouncing, and an input buffer that eliminates missed characters. Magic Wand super discount price $299.

FIELD PROVEN DESIGNS—After one year of MAPPER production, Omikron has established an impeccable reputation for reliability, integrity, and user support. Omikron's customers include the US Government, major corporations, universities, medical doctors, and professionals in all fields.

SYSTEMS—Omikron sells complete systems featuring Model II compatible Shugart disk drives. Call for prices and delivery.

FOREIGN ORDERS must include full payment in US funds plus $25 for air shipping and handling.

See review in July 80 BYTE By Jerry Pournelle.



Standard CP/M* OMIKRON

OMIKRON *Products that set Precedents.*
1127 Hearst St Berkeley, CA 94702 (415) 845-8013

*CP/M is a TM of Digital Research. TRS-80 is a TM of Tandy Corporation.

Circle 218 on inquiry card.

Listing 2 continued:

```
0025 3A53 5329
0029 203F
002B 00                 BYTE 0
002C 0D0A        MESS1  BYTE >0D,>0A
002E 5448 4520          TEXT 'THE NUMBER OF TICKS ELAPSED IS: '
0032 4E55 4D42
0036 4552 204F
003A 4620 5449
003E 434B 5320
0042 454C 4150
0046 5345 4420
004A 4953 3A20
004E 00                 BYTE 0
004F 2041 4E44   MESS2  TEXT ' AND THE CORRECT TIME IS: '
0053 2054 4845
0057 2043 4F52
005B 5245 4354
005F 2054 494D
0063 4520 4953
0067 3A20
0069 00                 BYTE 0
0067             COLON  EQU  $-3
                 *
                 *  PROGRAM BEGINS HERE
                 *
006A                    EVEN
006A             EXMPL  EQU  $
006A 0300 0000          LIMI 0                   ;INHIBIT INTERRUPTS
006E 02E0 00D6          LWPI MYWS                ;GET A WORKSPACE
0072 06A0 00CA          BL   @TYPE
0076 000B               DATA MESS0               ;GET TIME OF DAY
0078 2D60 0000          DIN  @HRS                ;HOURS
007C 2D60 0002          DIN  @MINS               ;MINUTES
0080 2D60 0004          DIN  @SECS               ;SECONDS
0084 06A0 00CA          BL   @TYPE
0088 0008               DATA CRLF                ;ISSUE NEW LINE
                 *
008A 06A0 0000          BL   @STIM               ;SET THE TIME OF DAY
008E 0000               DATA HRS
0090 06A0 0000          BL   @STCLK              ;ZERO THE INTERVAL TIMER
0094 0300 0001          LIMI 1                   ;ALLOW LEVEL 1 INTERRUPTS
                 *
0098             WAIT   EQU  $
0098 2C40               IN   R0                  ;WAIT FOR INPUT
009A 06A0 0000          BL   @RDCLK              ;READ THE TIMER
009E C140               MOV  R0,R5               ;SAVE THE VALUE
00A0 06A0 0000          BL   @GTIM
00A4 0000               DATA HRS                 ;READ THE CLOCK
00A6 06A0 00CA          BL   @TYPE
00AA 002C               DATA MESS1               ;PRINT 'THE NUMBER OF TICKS...'
00AC 2D85               DOUT R5
00AE 06A0 00CA          BL   @TYPE
00B2 004F               DATA MESS2               ;PRINT 'AND THE CORRECT...'
00B4 2DA0 0000          DOUT @HRS                ;PRINT HOURS
00B8 2CA0 0067          OUT  @COLON
00BC 2DA0 0002          DOUT @MINS               ;PRINT MINUTES
00C0 2CA0 0067          OUT  @COLON
00C4 2DA0 0004          DOUT @SECS               ;PRINT SECONDS
00C8 10E7               JMP  WAIT
                 *
                 *  TYPE THE MESSAGE POINTED
                 *  TO BY THE RETURN ADDRESS
                 *
00CA             TYPE   EQU  $
```

Listing 2 continued on page 300

Listing 2 continued:

```
00CA C03B              MOV   *R11+,R0        ;GET POINTER
00CC            TYPE1  EQU   $
PAGE-3 RTC DEMONSTRATION

    00CC D070              MOVB  *R0+,R1         ;GET A CHARACTER
    00CE 1601              JNE   TYPE2
    00D0 045B              B     *R11            ;NULL IS END
    00D2            TYPE2  EQU   $
    00D2 2C81              DOUT  R1              ;PRINT THE CHARACTER
    00D4 10FB              JMP   TYPE1
                    *
    00D6            MYWS   BSS   32              ;WORKSPACE AREA
                    *
    00F6                   END
  0067 COLON   0008 CRLF  *2D48 DIN   *0000 DIO  *2D88 DOUT
 *0000 EXIDT  *006A EXMPL  00A2 GTIM   0000 HRS   000B MESS0
  002C MESS1   004F MESS2  0002 MINS   00D6 MYWS   0000 R0
  0001 R1     *000A R10    000B R11   *000C R12  *000D R13
 *000E R14    *000F R15   *0002 R2    *0003 R3   *0004 R4
  0005 R5     *0006 R6    *0007 R7    *0008 R8   *0009 R9
  009C RDCLK  *0000 RTC    0004 SECS   0092 STCLK  008C STIM
 *0006 TICKS   00CA TYPE   00CC TYPE1  00D2 TYPE2  0098 WAIT
OUTPUT READY?
00000EXIDT    A0000A0008B0D0AB000DB0A45B4E54B4552B2054B494DB4520B4F467F0FBF
B2044B4159B2028B4848B3A4DB4D3AB5353B2920B3F00B0D0AB5448B4520B4E557F178F
B4D42B4552B204FB4620B5449B434BB5320B454CB4150B5345B4420B4953B3A207F1ACF
B0020B414EB4420B5448B4520B434FB5252B4543B5420B5449B4D45B2049B533A7F1B9F
B2000B0300B0000B02E0C00D6B06A0C00CAC000BB2D60C0000B2D60C0002B2D607F1D1F
C0004B06A0C00CAC0008B06A0B0000C0000B06A0B0000B0300B0001B2C40B06A07F202F
B0000BC140B06A0B0000C0000B06A0C00CAC002CB2D85B06A0C00CAC004FB2DA07F18CF
```

Listing 2 continued on page 302

Circle 224 on inquiry card.

MICAH

OSBORNE COMPATABLE READY to RUN BUSINESS SOFTWARE

in CBASIC2 or 16K BASIC

★ *features* ★

- Four Complete Packages---
  - General Ledger
  - Accounts Receivable
  - Accounts Payable
  - Payroll with Cost Accounting
- Strong support from Osborne Manuals
- CBASIC2 runs under CP/M or under CDOS version 1.07 on Cromemco computers
- 16K BASIC runs on Cromemco computers
- Cursor addressing routines for Hazeltine, Lear Siegler and Cromemco (Beehive) Terminals
- Source Codes and Installation Instructions provided along with disks
- Automatic Command Start-up
- Easy to apply to all of your business and systems needs

★ *hardware required* ★

- One or more 8" or 5" Floppy ★ Drives
- CRT with cursor addressing
- 132-Column Printer

$145⁰⁰ per package

TO ORDER
Add $5 for shipping
Calif. add 6-1/2% Sales Tax
CREDIT CARDS ACCEPTED

Osborne Manuals $25 each

• DEALER INQUIRIES INVITED •

- OSBORNE READY to RUN BUSINESS SOFTWARE
- SRIOS(CP/M for Cromemco computers)
- X-IOS(MP/M for Cromemco Computers)
- EXPAND(Run Cromemco Software on CP/M)
- MICROPLOT(Versatile Printer Graphics)
- DRIVE(Customized Printer Drivers)
- DUP 3(Disk Utilities for Cromemco
- DUP 4(Double sided)
- DUP 5(Disk Utilities for CP/M
- DUP 6(Dbl. Density)

• Call or Write for Free Catalogue and More Information •

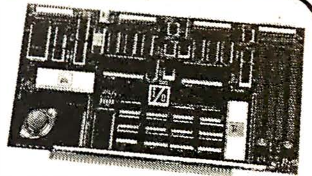
★ We will Customize any of our programs at our Standard Consulting Rates ★

☆ All orders usually shipped 8"
For 5" disks add $20.00 for downloading

MICAH BOX 4087 WALNUT CREEK, CALIF. 94596 ph. 415/933-2783
MICro Applications and Hardware
• CONSULTANTS and SOFTWARE DEVELOPERS •

Circle 225 on inquiry card.

S-100 MULTI-FUNCTION I/O BOARD



Has two serial Sync/Async ports (RS-232, current loop or TTL) with individual Xtal controlled programmable baudrate generators. Four 8-bit Parallel ports; one latched input port and other three can be programmed in combinations of input, output or bidirectional. Also, has three 16-bit Programmable Timers and an 8-level Programmable Interrupt Controller w/Auto restart (8080 / Z80). Other features include; on-board clock divisor for timers, completely socketed, wire wrap posts for easy port configuration plus more.

A & T w/user's Manual . . . .(P/N 52748-100) **$375.00***

S-100 "SMART" PROTOTYPING BOARD

Provides flexibility with our Bus Bar matrixed power distribution. Our "SMART" Prototyping Board allows building your circuit(s) with ease and saves you hours of power busing layout time. Ideal for Memory, CPU, I/O, A/D, D/A, Disk Controller, etc. Accepts all standard .300" and .600" row spacing I/Cs or sockets. Top row on .100" center spacing allows mounting of standard Header Connectors.

Kit—includes two Bus Bars with Power Supply (+5V, ±12V) components (as shown on photo) . . . . . . (P/N 52748-400) **$49.95***

Board only. . . . . (P/N 52748-4XX) **$29.95***

*Calif. Residents Add 6% Sales Tax. U.S. Domestic Price. Price Subject To Change Without Notice.

FOR MORE INFORMATION CALL OR WRITE;

I/O TECHNOLOGY
P.O. Box 2119
Canyon Country, CA 91351
Phone (805) 252-7666

Combine accurate flight characteristics with the best in animation graphics and you'll have SubLOGIC's

T80-FS1 Flight Simulator for the TRS-80

SubLOGIC's T80-FS1 is the smooth, realistic simulator that gives you a real-time, 3-D, out-of-the-cockpit view of flight.

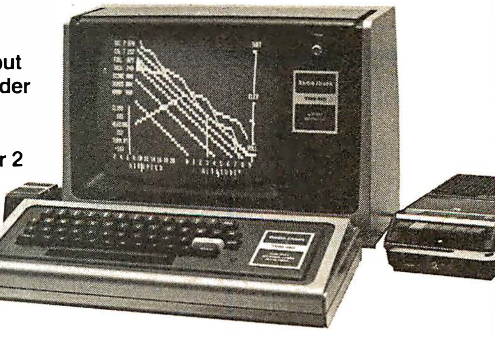
Thanks to fast animation and accurate representation of flight, the non-pilot can now learn basic flight control, including take-offs and landings! And experienced pilots will recognize how thoroughly they can explore the aircraft's characteristics.

Once you've acquired flight proficiency, you can engage in the exciting British Ace 3-D Aerial Battle Game included in the package. Destroy the enemy's fuel depot while evading enemy fighters.

Computer and aviation experts call the T80-FS1 a marvel of modern technology. *You'll* simply call it *fantastic!*

Special Features:
- 3 frame-per-second flicker free animation
- Maximum transfer keyboard input
- Constant feedback cassette loader

Hardware Requirements:
- Radio Shack TRS-80, Level 1 or 2
- 16K memory
- *Nothing else!*



Only $25

See your dealer or order direct. For direct order, include $1.25 and specify UPS or first class mail. Illinois residents add 5% sales tax. Visa and Mastercard accepted.

subLOGIC
Distribution Corp.
Box V, Savoy, IL 61874
(217) 359-8482

Circle 226 on inquiry card.

Circle 227 on inquiry card.

Listing 2 continued:

```
C0000B2CA0C0067B2DA0C0002B2CA0C0067B2DA0C0004B10E7BC03BBD070B16017F188F
B045BB2C81B10FB40000DID    5006AEXMPL 300A2GTIM  3009CRDCLK 40000RTC   7F02CF
30092STCLK 3008CSTIM   000F6         7F893F
:

EDIT/ASM/LOAD?
```

Listing 3: *Execution of the demonstration program of listing 2.*

```
ENTER TIME OF DAY (HH:MM:SS) ?20:49:40

THE NUMBER OF TICKS ELAPSED IS: 2 AND THE CORRECT TIME IS: 20:49:42
THE NUMBER OF TICKS ELAPSED IS: 16 AND THE CORRECT TIME IS: 20:49:56
THE NUMBER OF TICKS ELAPSED IS: 26 AND THE CORRECT TIME IS: 20:50:6
THE NUMBER OF TICKS ELAPSED IS: 430 AND THE CORRECT TIME IS: 20:56:50
THE NUMBER OF TICKS ELAPSED IS: 444 AND THE CORRECT TIME IS: 20:57:4
?G406A

ENTER TIME OF DAY (HH:MM:SS) ?23:59:30

THE NUMBER OF TICKS ELAPSED IS: 5 AND THE CORRECT TIME IS: 23:59:35
THE NUMBER OF TICKS ELAPSED IS: 17 AND THE CORRECT TIME IS: 23:59:47
THE NUMBER OF TICKS ELAPSED IS: 26 AND THE CORRECT TIME IS: 23:59:56
THE NUMBER OF TICKS ELAPSED IS: 38 AND THE CORRECT TIME IS: 0:0:8
?G406A

ENTER TIME OF DAY (HH:MM:SS) ?23:61:23

THE NUMBER OF TICKS ELAPSED IS: 2 AND THE CORRECT TIME IS: 0:0:2
THE NUMBER OF TICKS ELAPSED IS: 9 AND THE CORRECT TIME IS: 0:0:9
?
```


Circle 228 on inquiry card.

VICTOR... Number 1 in Impact Matrix Printing!

Model 5080

A Unique Printing Terminal

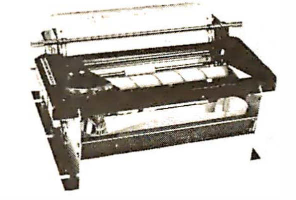
- 80 column, bi-directional printing
- Upper & lower case font
- Full graphics — 480 columns per line
- Top of form & horizontal tabs
- True 100 cps throughput
- Bi-directional friction and sprocket paper feed
- Large 360 character buffer
- Four interfaces — standard parallel & RS232 & TTY & IEEE-488
- Baud rate switch selectable
- Self-test
- UL/CSA approved
- Intelligent shortest path head return

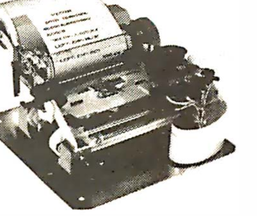
The Model 5080, shown above, is a heavy-duty printing terminal offered for sale at most competitive prices. Only $995 in single quantity! This printer has been designed to conform to the most stringent computer specifications, including software on/off control, status feedback signals and a busy signal should you fill our extra large buffer. Don't delay, order now to insure early delivery!

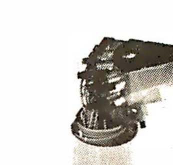
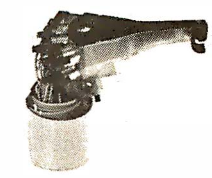
Victor has delivered more than 700,000 industrial, quality matrix printers. These are terminals, mechanisms, and heads designed to solve your problems. Products that are backed by a strong application engineering staff, worldwide service and 50 years of Victor pride in product.

A Complete Line of Impact Matrix Printers


Model 5010


Model 80


Model 130



Model 129

VICTOR DATA PRODUCTS
Subsidiary of Walter Kidde & Company, Inc.
KIDDE
3900 North Rockwell Street, Chicago, Illinois 60618 Telephone: 312-539-8200

GREAT BRITAIN — DATAPLUS, 0242-30030 **GERMANY** — BDT, (07 41) 8041 **ITALY** — C.A.I., 23.63.851
SPAIN — CETA, 254 6607 **SWITZERLAND** — ERNI, 01 833 33 33 **CANADA** — MUNRO, (416)676-1042
FRANCE — METROLOGIE, (1) 791 44 44 **SOUTH AFRICA** — EAGLE, 45-1421
SINGAPORE — OG, 917788 or 918592 **HONG KONG** — GILMAN, 3-427144

Circle 229 on inquiry card.

Book Reviews

Microcomputers and Physiological Simulation

James E Randall
Addison-Wesley
Reading MA, 1980
234 pages, hardcover
$14.50

The observation of living systems is often a complex and difficult task; for those amateur or professional scientists who spend their time investigating the life signs and physiological responses of man and other animals, the use of laboratory computers in the data-gathering phase of their research has become a necessity. In most cases, the invasion of computers into the laboratory environment started with the advent of minicomputers such as the LINC (Laboratory Instrument Computer) and later, the Digital Equipment Corporation PDP-12. The relatively low-cost and single-user nature of these systems made them especially attractive to the scientist willing to learn computer science. A typical installation would be optimized for data acquisition and formatting, and sophisticated data analysis, simulation, and modeling would generally be done on large, centralized mainframes such as the IBM 360-91. Time on these large machines was not cheap, and the budgets required to support extensive simulation studies were often prohibitive. For these reasons, the study of biological systems by simulation has tended to be restricted and specialized in nature.

With the arrival of microprocessor hardware and software systems at much lower cost than minicomputers, and with the development of special-purpose, high-speed arithmetic-processing units, creative and generalized simulation studies may now be performed with a rather modest expenditure of money; of course, inexpensive computing tools do not necessarily reduce the total cost of developing the correct system for a particular application. Here is where Dr Randall's book is invaluable: the background information on microprocessors, combined with specific examples of biological data simulated with various hardware and software configurations, should allow any life-science experimenter to progress rapidly from the initial idea to a working simulation model.

The first chapters of the book describe the basic realities of the microcomputer world in a clear and comprehensive fashion; the various evolutionary trends in hardware and software design which gave rise to some of the more popular present-day microprocessor systems are explained in a cogent and enlightening manner that should orient

the neophyte user amidst the growing maze of specifications and performance figures that seem to characterize the technical aspects of microprocessing. Thus, several years of practical experience have been condensed into what will soon be an indispensable reference for anyone considering the mathematical study of physiology.

In addition to people doing research, *Microcomputers and Physiological Simulation* should help those who would like to use interactive modeling as a teaching or demonstration device. All too often, an actual experiment may not turn out as expected, or the number of people observing the demonstration is so large that no one learns very much. Given these circumstances, a simulation approach for showing the dynamic realities of various physiological functions is both a clever and necessary approach. For example, in the study of cardiac output and central arterial pressure, a student could make a number of "experimental" manipulations of the circulatory system which would, on one hand, help to clarify what really goes on in an intact organism, but which, on the other hand, would be difficult to do within the confines of an experimental preparation. In addition, the time required to load a software model of the heart is much less than that needed to set up a live experiment (and, of course, the overall cost of simulation is likely to be much less than the real thing). So, given the desire to provide better instruction and reduce the time and money needed to give students first-hand experience in physiology, a teacher in the life sciences should consider carefully the interesting and useful techniques developed in this book.

Several of the examples in this book are extensions of topics that have been the subjects of articles in BYTE; the electrocardiogram (ECG) receives considerable attention, as does the nature of the neuronal axon potential and membrane conductances following various stimulation examples. In addition, the section on digital filtering and waveform distortion is relevant to a wide range of engineering and computer-science applications outside the life sciences. If you already have an Apple II, an S-100-based system, or a TRS-80 system, several BASIC language programs are provided so that you can get up and running immediately; acquisition of the appropriate arithmetic-processing option for your microprocessor will allow you to run more sophisticated and more dynamic simulation studies in a reasonable amount of time.

In a larger context, *Microcomputers and Physiological Simulation* is one more contribution to the field of personal, interactive microprocessor-based teaching tools which in specific circumstances offer numerous advantages over conventional methods; the creativity and breadth of investigation allowed by flexible and well-conceived software and hardware systems are in many ways much greater, and certainly achieved with less effort, than our present experimental and pedagogical methods support. Of course, for undergraduate or graduate education and research, having a group of students organize and implement one of the simulations described

in this text will not only provide them with an interesting tool within their specific field of study, but will also allow them to know in some depth the basics of the microprocessor environment which has become an essential substrate of almost all avenues of scientific and laboratory undertaking. Judging by the possibilities offered in Dr Randall's present work, the contribution of the microprocessor to laboratory science and technical education will be enormous. Comprehensive guides of this sort serve to allow everyone easy access to a much more evolved set of teaching and experimental tools than has been available before. ■

Nicholas Bedworth
Microtex
45 Trowbridge St
Cambridge MA 02138

Microcomputer-Analog Converter Software and Hardware Interfacing

Titus, Titus, Rony, and Larsen
Blacksburg Continuing Education Series
Howard W Sams, 1978
286 pages, softcover
$9.50

Microcomputer-Analog Converter Software and Hardware Interfacing is a textbook intended for either class use or self-study. It includes learning goals for each chapter, a chapter of experiments, and a large number of hardware and software illustrations. All software in the book is for the 8080 microprocessor; conversion to other 8-bit microprocessors would range from trivial to moderately difficult.

The topics covered are: analog-to-digital (A/D) and digital-to-analog (D/A) conversion, interfacing digital panel meters, sample-and-hold and multiplexer circuits, and miscellaneous conversion techniques. Appendices include data sheets and applications notes for a wide range of D/A and A/D devices ranging in cost from a few dollars to a few hundred dollars.

The reader of the book is assumed to be familiar with analog circuitry, with digital circuitry, and with 8080 programming. The level of familiarity required for analog devices is about the same as any radio amateur above the Novice class would have. The digital and computer familiarity are at about the same level; anyone who knows what a three-state buffer is and what the difference is between polled and interrupt-driven I/O (input/output) should have no trouble with the text. Both polled and interrupt-driven systems are discussed, by the way, along with point graphics and measurement systems.

All in all, this is a good introduction to digital-to-analog interfacing, and a good reference book. The utility as the latter would be increased if there were a good descriptive index of the devices discussed. As with many of the books in this series, there are no blank pages in front or at the back for notes; most readers will probably want several pages of notes, so this is irritating. ■

John A Lehman
716 Hutchins #2
Ann Arbor MI 48103

Engineer's Notebook: A Handbook of Integrated Circuit Applications

Forrest M Mims III
Radio Shack Technical Publications

128 pages, softcover
$1.99

Engineer's Notebook is a collection of hundreds of simple circuits using integrated circuits, each one neatly hand-drawn and labeled, with all of the details (resistor and capacitor values, transistor numbers, etc) filled in. The devices used are primarily TTL (transistor-transistor logic), CMOS (complementary metal-oxide semiconductor), and linear function circuits.

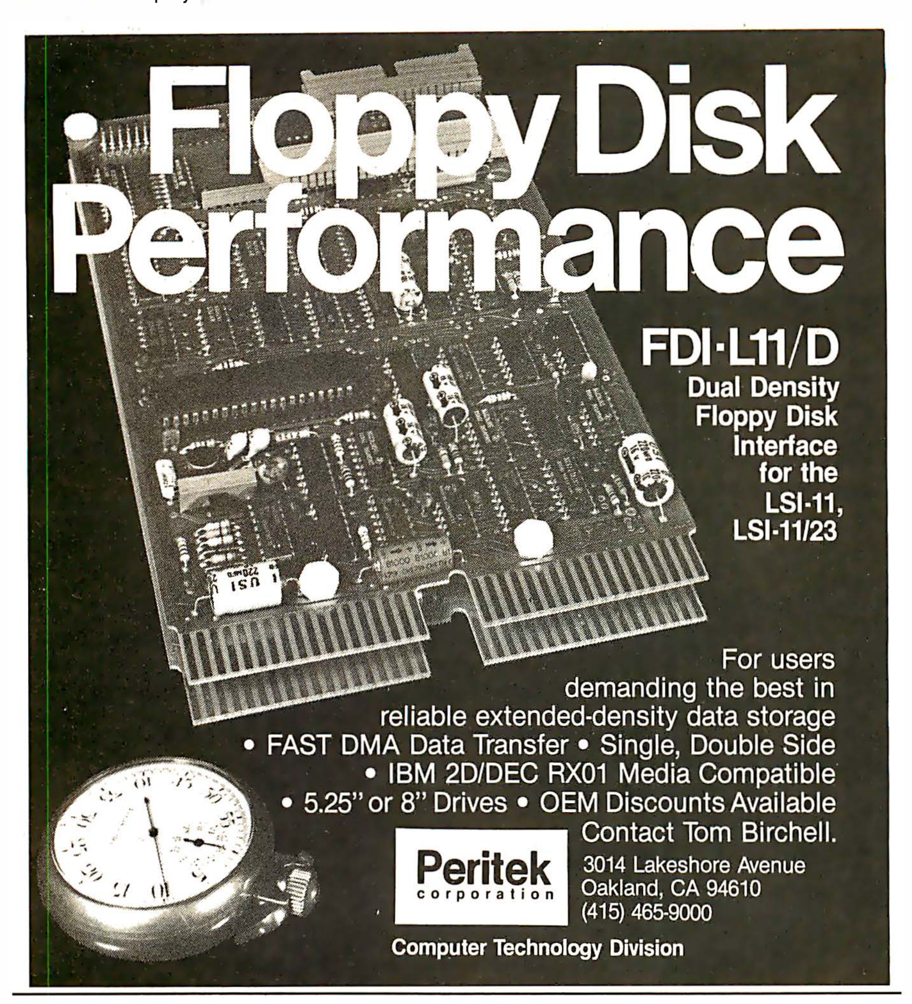
As a programmer, I keep a file of useful subroutines for each machine and language with which I work. As the file grows, programming gets easier because more chunks of new programs come straight out of the file. *Engineer's Notebook* is the start of my circuit file. Since I am a novice to electronics, I simply cannot say whether an experienced circuit designer will find this collection useful. I tend to doubt it; the book is not written for him. For beginners, however, the circuits are a real help. Not necessarily because they will fit right into the next project you build, but because of the help they provide in learning how to use integrated circuits.

After a *very* brief (four-page) introduction to basic electronics (where you are told what resistors, capacitors, and semiconductors are for), the book launches into CMOS circuits. In about forty pages it presents various circuits, starting with the use of simple gates and moving through switches and decoders, flip-flops and counters, memory devices, and a variety of music- and noise-generating devices including the SN76488N complex sound generator. The TTL section covers simple *gate* circuits (including a couple of very informative pages on the use of Schmitt triggers), oscillators, selectors and decoders, then counters and dividers. The linear circuits include pages and pages of op-amp applications, LED (light-emitting diode) bar displays, tone decoders, and uses for voltage-controlled oscillators.

If you do not know much about electronics and if you want to learn how to use integrated circuits, I suggest you buy one of Don Lancaster's "cookbooks" (or some other introductory text), and *Engineer's Notebook*. Use it as a workbook for the text; think of the circuits as answers to questions the text did not pose. Go through them using the text and figure out why they work. Answer the question: Why use this value resistor (capacitor, transistor)? Before very long, you will know what you need to know.

I bought the book primarily to learn about TTL. However, because of the variety of circuits presented, I find myself more interested in CMOS and somewhat intrigued by linear circuits. I'm studying all three now. The book is well worth its two-dollar price no matter what use you make of it. ■

Richard Fritzson
25 Callodine Ave
Amherst NY 14226



Book Reviews

Microcomputer Interfacing with the 8255 PPI Chip

Paul F Goldsbrough and
Peter R Rony
Blacksburg Continuing Education Series
Howard W Sams, 1979
224 pages, softcover
$8.95

Those who remember the integrated circuits available a year or two ago may wonder how an entire book could be devoted to a single nonmicroprocessor device. The traditional documentation for such a component is "U25 on the System Monitor Board is a Motorola or equivalent 6820 PIA that contains two parallel I/O ports....In order to use it however, it must be set up with the proper software" (*TDL System Monitor Board Manual*). The 217 pages in this book are devoted to showing how the software and hardware for the Intel 8255 PPI (programmable peripheral interface) are set up. The general description (although not the details) is applicable to similar devices such as the above-mentioned 6820 (now 6821) or the Texas Instruments 6011.

The 8255 is a parallel interface device which allows software configuration of up to twenty-four I/O (input/output) lines. It has three basic modes: simple, handshaking I/O, and bidirectional. Up to three different ports may be used (depending on the mode), for input, output, or both. All of this makes the 8255 very flexible; it also makes it complicated.

The book discusses I/O schemes in general, and each of the 8255 modes in particular. Experiments are given for both port- and memory-mapped I/O. All hardware and software illustrated are for an 8080-based system, but the effort required to translate to another microprocessor is minor. Both polled-device

and interrupt-driven I/O are treated, and the book ends with an excellent discussion of the hardware and software requirements for master/slave processors. This section alone is worth the price of the book.

There are, as usual, a few minor faults. On page 63, the diagram of the hex inverter is not labeled; it is a 74xx04. Numbers in the book are sometimes given in octal and sometimes in decimal radix; unfortunately the author often neglects to mention which base he is using. I suppose ideally he ought to give everything in octal, decimal, and hexadecimal, but this convenience is probably not needed by the relatively sophisticated audience at whom this book is aimed.

Personally, I find it hard to read an assembler output such as that in the text which runs the op codes and the operands together. PUSH PSW is much easier to read then PUSHPSW. Finally, I would like a *bookwide* index of the experiments; it would make the book more useful as a reference.

But all of this is quibbling; the book is more than worth the price if you fall into one of three groups of readers. The first group is made up of people who have an elementary knowledge of digital logic (perhaps gained from some of the other Blacksburg books) and who want to learn how to use programmable interfaces in general and the 8255 in particular. The second group is made up of those who would like a more readable reference to the 8255 than is provided by the data sheet, and who want to see sample hardware and software interfaces. Last, anyone putting together multiple-processor systems would do well to look at the last section of the book for a quick and dirty, but fairly simple, way to do it. Let's see, how many channels should I put on my Z80...?■

John A Lehman
716 Hutchins #2
Ann Arbor MI 48103

Thrice Upon a Time

James P Hogan
Ballantine Books, New York NY, 1980
311 pages, softcover
$2.25

Technical books and journals are useful for reference facts. Magazine articles and "construction" books supply the latest in the microcomputing art to sharpen our faculties. But these all address the issue of "how," and nourish the intellect with data. Books such as James P Hogan's latest novel, *Thrice Upon a Time,* answer a far more primal need. When the soul is anguished by a floppy disk's stubborn recalcitrance; when the heart is discouraged by that elusive last bug in the sorting routine; when the mind is depressed by the manufacturer's twelfth postponement of his shipping date, the solace from this book's visions is a soothing balm that carries one through to try again tomorrow.

To be sure, Mr Hogan's intricate plot far transcends mere home computing. In his story, which is concerned with some natural disasters and some achievements of mankind, he intertwines causes and effects so that each nourishes the other in an exciting race to enjoy the benefits of achievement without having to bear the extreme price the consequences of the advances seem to engender. Exploring this theme, plus presenting it in a bolero of variations, is a most complex plot concerning a time communications machine. As distinct from the mysteriously operating transporting telephone booths of the H G Wells or Dr WHO variety, Hogan presents a rather well-documented, even plausible, invention that takes advantage of the Tau wave effect. Now I am sure that Tau waves are not familiar phenomena to many readers. Mr Hogan also is cognizant of this deficiency in the physics background of most of us, and so he presents an explanation of this effect, its discovery and usefulness, with such clarity and vividness that one would no more deny Tau wave existence than one would deny gravity, black holes, or positronic brains. Though I leave the details to Mr Hogan's characters, suffice it for the moment that Sir Charles has invented a means to send messages back in time.

Now imagine, if you will, that the world is faced with a problem; a big one. Say we notice by June, when we are already steeped to our knees in the problem (figuratively), that if we had known to do some "X" back in January, most of this trouble would be nonexistent. Say we do send a warning back. Would that mean that we are no longer troubled, or that we no longer are, at all? Then why, or who, would have sent the message?

Yes, this paradox has been explored before. But a marvelous craftsman and clear thinker such as James Hogan deserves his platform, and he exploits it with the quintessential detail and plausibility so reminiscent of the John W Campbell era.

So, you may concede, it's a gripping story. But where does my Altair or Apple come in? The answer is on just about every page. It is assumed in the story that at that time, 30 years from now, most people have a working knowledge of high-level languages. The elderly Sir Charles has a small computer in his home, and it is not a remarkable occurrence. When he needs extra computing power or common data, he doesn't think twice about linking into the national data grid, which offers such services, as any other utility would offer its resources to home users today. What is so all-fired exciting about this story is that Sir Charles, with a setup not too different from what is available right now to us in our computer rooms, has sat down and used that computer to make a *time machine.* Sure he has access to a Tau wave generator, which most of us still would have trouble acquiring. But if Sir Charles can move such mountains with his setup,

surely we can at least move a few molehills with ours.

The book is top-notch. As a story, it's exciting and involving. As an inspiration, well I don't want to write any longer. My microcomputer awaits.

Jay P Lucas
3409 Saylor Pl
Alexandria VA 22304

Noise Reduction Techniques in Electronic Systems

Henry W Ott
John Wiley & Sons
New York NY, 1976
294 pages, hardcover
$24.50

Although frequently unrecognized, electrical noise is a serious problem in the microcomputing environment. The home microcomputer is a recognized source of electromagnetic interference (EMI) or radio-frequency interference (RFI). The sound effects of computer games produced on a nearby radio are the mark of clever programming and poor electromagnetic shielding. Further, many prototype or even final versions of digital and analog projects fail completely or suffer occasional untraceable glitches because of improper attention to noise sources. Additionally, the rush to marry the continuous, frequently low-level, analog signals to fast-switching, noisy digital microcomputers promises many tremendous EMI problems. Intolerably, from tens to hundreds of millivolts of digital noise may appear in analog signals that never exceed 10 V and are frequently in the 0.1 V to 1 V range.

The above problems can be solved by the application of information about noise—preferably done systematically in the initial design rather than as a patchwork correction after the fact. Ott's extremely well-written book contains this information and is one of the finest books on electrical noise, its sources, propagation, reception, and suppression. This book is an outgrowth of lectures at Bell Laboratories, and is directed at a technician-level two-year college program.

Chapter 1 is a lucid discussion of noise sources, their coupling into your system, and a summary of the elimination methods: shielding, grounding, balancing, filtering, isolation, separation and orientation, circuit impedance control, cable design, and cancellation. The remainder of the book expands on these points.

Chapter 2 discusses the theory of shielding conductors, and why it does not always work. The distinction between capacitive and inductive coupling is carefully made. Grounding schemes for cables are clearly shown along with their relative merits.

Chapter 3 discusses procedures for minimizing ground loops, low-frequency and high-frequency grounding (they are different), and grounding shields properly. Especially important, and carefully treated, is the elimination of ground loops.

Chapter 4, "Other Noise Reduction Techniques," discusses balancing, power-supply decoupling, the much misunderstood transmission impedance of a power distribution system and its effect on system performance, high-frequency decoupling filters and digital circuits. Chapter 5, "Passive Components," shows how these poorly appreciated components can dramatically affect system performance.

Chapter 6 is "Shielding Effectiveness of Metallic Shields" and is full of pleasant and unpleasant surprises about shielding properly. Ott discusses in detail how to really prevent EMI generation or reception.

Chapter 7 is on "Contact Protection" in switches and relays. This unlikely sounding chapter in a book on noise suppression is quite logical. Switches and relays are notorious sources of EMI, and contact protectors yield improved life and performance and also have the beneficial effect of reducing EMI.

Chapters 8 and 9 are about intrinsic noise sources and active-device noise. These two chapters are of greatest value for low-level analog measurements rather than for microcomputer uses.

This book is not easy to read, as it assumes familiarity with DC circuit theory as well as with capacitors, inductors, and the complex impedance treatment of AC circuits. This level of expertise is not required for the book to be exceedingly valuable, however. It is clearly written with a lot of examples and good problems with their solutions.

Like a good novel, it was difficult for me to put this book down. The physical

significance of an equation is discussed clearly and at length; abundant graphs demonstrate concepts and provide valuable later reference. Finally, Ott is exceedingly practical. He has obviously spent long hours up to his elbows in wire and soldering irons tracing down and eliminating noise bugs, and he tells you his secrets.

The book is full of useful and interesting facts. For example, the switching of a single transistor-transistor logic (TTL) gate connected to a power supply through 10 inches of 22 gauge wire causes the ground connection of the integrated circuit to jump by 0.4 V. The synchronous switching of five gates could cause the ground to rise to 2 V! Since 2 V is the logic threshold for transistor-transistor logic, proper operation would be unlikely. This particular problem, a common cause of malfunctions in breadboarded circuits, is partially solved by bypass capacitors.

Do you know how a power-distribution bus strip works? Why a double-sided printed-circuit board can give far better performance than point-to-point wiring, even with very heavy wire, or even a single-sided printed-circuit board? How much ground area do you need on a printed-circuit board? Do you know what a ferrite bead is, and how it suppresses noise? Do you know what the best type of filter capacitor for filtering an input line is? (The answer is not ceramic disc.) Why is copper a better magnetic shield than steel at high frequencies? How do you seal a cabinet door to EMI? Why, in a cabinet, does a series of ventilating holes with a total area of 1 square inch leak far less EMI than a single crack in the door with an area of 0.1 square inches? Ott explains this plus much more.

The book has a few shortcomings. The author does not always tie separately presented concepts together, and the reader must perform this synthesis. I would also like to have seen more information on power-line EMI filters. The book was not written with computers in mind so there are no explicit references to them. The information on digital circuits is very brief. Counterbalancing these problems is the fact that the book does not deal with obsolete technologies, but handles fundamental principles which will always be a proper starting point for attacking a new area.

In summary, this is an excellent book. It should be read by every serious analog/digital designer. A careful reading and application of Ott's principles will save great pain, hours of labor, money, and in some cases even entire projects. ■

J N Demas
Department of Chemistry
University of Virginia
Charlottesville VA 22901

BYTE's Bits

Tracking Down the Modem Filters

Since my article "An Answer/Originate Modem" was published in the June 1980 BYTE (page 24), I have found that the company which makes the CH1262 and CH1267 filters has moved. The current address and telephone number are:

Cermetek Microelectronics
1308 Borregas Ave
Sunnyvale CA 94086
(408) 734-8150

The filters are available as "miniModem" building blocks from this firm.

Ronald G Parsons
9001 Laurel Grove Dr
Austin TX 78758

The Source and Tymshare Sign Operations Agreement

Source Telecomputing Corporation and Tymshare Inc have entered into a development and pilot operation agreement under which Tymshare, a computer service company, will provide a variety of facilities and services to increase the user capacity of The Source, an information utility. Tymshare's subsidiary, Tymnet Inc, which operates the TYMNET public packet-communications network serving 200 cities, will be utilized in The Source's expansion program. The number of Source users, now approaching 5000, has increased beyond the system's present capabilities. Utilizing TYMNET's equipment and expertise will better serve existing users and permit The Source to accommodate thousands more.

Through The Source, owners of home computers, computer terminals, and word-processing equipment are able to access a variety

of data bases and programs by telephone connection to computers of The Source network. For details, contact The Source, Source Telecomputing Corporation, 1616 Anderson Rd, McLean VA 22102, (703) 821-6660.

Heath Offers Source Code to Its Customers

Heath Company, Dept 350-390, Benton Harbor MI 49022, (616) 982-3210, is offering to its microcomputer customers source code for the company's internally developed system software and hardware. Source code to be released include those for Heath's cassette assembler, debugger, editor, and BASIC, and the source code for HDOS, Heath's disk operating system. Also being offered are the firmware for the H-17 and H-89 disk controllers and the firmware for the H-19 video terminal. The source code listings are $25 each except for HDOS, which is $195. The H-19 code will also include source on a Heath HDOS floppy disk and the character generator ROM (read-only memory) code. HDOS source code is available on floppy disk and includes the disk Assembler, Editor, BASIC, and DBUG, as well as PIP and other utilities. All products remain copyrighted, and even though source code is available, it is not being placed in the public domain. Heath welcomes licensing discussions for HDOS from other manufacturers.

Computer Bulletin Board for Radio Amateurs

A free access program, called HAMNET, was established by Donald Stoner, W6TNS, and The Peripheral People, POB 524, Mercer Island WA 98040, (206) 232-4505. HAMNET utilizes the extensive MicroNet communications network, which allows access through almost two hundred local telephone numbers. Checking into HAMNET permits users to post and retrieve messages for help wanted, equipment for sale, network news, schedules, and so on. Other features planned are propagation forecasts, Federal Communications Commission (FCC) news, new product announcements, and more. Public-domain programs are also available. HAMGAB is a ham "frequency" for two users to communicate or transfer programs. While the system is primarily oriented towards amateur radio buffs, it is open to all MicroNet customers. A subscription to MicroNet is $9 and $5 per connect hour. Customers are given a 128 K-byte block for storage of files. Information is available from Personal Computing Division, CompuServe Inc, 5000 Arlington Centre Blvd, Columbus OH 43220.

New TRS-80 Keyboards

Radio Shack has announced an important change in its TRS-80 Model I microcomputer. The new keyboard that uses a capacitive-contact system to eliminate the well-known keyboard debounce problem does not have removable key caps, which were on the older TRS-80 models. Any attempt to clean the keyboard by removing the key caps will result in damage to only those TRS-80s that have the new keyboard. TRS-80s with the new keyboard are distinguished by a dull (as opposed to a shiny) finish on the keys and a curved (as opposed to a straight) slope of the keyboard tops when viewed from the side.

Educational Software for the Apple

The Department of Natural Science at Eastern Kentucky University, Memorial Science 220, Richmond KY 40475 (606) 622-3735, has completed a search for educational courseware written for microcomputers. They have compiled a catalog of educational software for the Apple II computer. Schools may obtain a copy of this catalog by writing to Professor John Wernegreen at the above address. ■

BYTE's Bugs

Catching the Khachiyan Bug

In Part 1 of "Khachiyan's Algorithm" by Berresford, Rockett, and Stevenson (August 1980 BYTE), a typographical error occurred in an Editor's Note by Gregg Williams (GW) at the bottom of the first column on page 202. The error at the end of line 7 of the italicized paragraph is in the equation

$$t = K_n^p$$

The correction is

$$t = Kn^p.$$ ■

Technical Forum

A $5.25 Interface to the BSR X-10 Home Control System

Alan R Trimble, Tracon Corporation, 6615 Kentland Ave, Canoga Park CA 91307

The availability and reasonable cost of the BSR X-10 Home Control System, coupled with the ease of interfacing the system to a home computer, will undoubtedly spawn a revolution in home automation. (See Steve Ciarcia's article "Computerize a Home," January 1980 BYTE, page 28.) Already I have seen advertisements in BYTE and other computer magazines for interface equipment in the $100 to $200 range, offered by at least three different manufacturers. Eager to get my home under computer control, but not too eager to shell out $114.90 for the S-100 MicroMint system described in Steve's article, I was motivated to implement the system in software.

All that is needed is an ultrasonic transducer and a single bit from a parallel output port. The transducer is simply connected directly across the output port line (transistor-transistor logic [TTL] levels are sufficient to drive the capacitive transducer load) while the computer is used to generate the 40 kHz bursts that make up the coded message to be transmitted to the BSR X-10 command module.

The output port was easy to come by—I had a spare one—but even a single line from a dedicated port could be used, such as a bit from a parallel printer-interface port, provided that the printer is not strobed when data is output to the port. Finding a 40 kHz ultrasonic transducer did not seem quite as simple. After calling a few local electronic stores, however, I was able to locate one for $5.25 (Calectro catalog number J4-815).

All tools in hand, I set out to emulate Steve's command generator in software on my 4 MHz Z80-based S-100-bus system. The calling sequence was set up so that the routine could be called using Cromemco's FORTRAN, but it is a simple matter to modify this as required.

At the heart of the program are two subroutines: FORTY, which generates a 40 kHz signal of specific duration, and DLY, which provides a programmable delay. These make careful use of instruction execution times to provide accurate timing. As written, they will work only with Z80/8085 systems running at a basic clock rate of at least 4 MHz.

FORTY and DLY are used in subroutines SND1, SND0, and TERM, which generate the transmission codes for a logic 1, a logic 0, and the code-termination sequence, respectively.

These, in turn, are utilized by the main routine XMIT,

which builds the message to be transmitted from the single-byte code passed as an argument. The code passed is exactly as described in table 1 of Steve's article.

Admittedly, the software required to drive the transducer is neither processor nor speed independent, but the concept is simple enough to be used on virtually any system.

Listing 1: *This software, called from Cromemco FORTRAN, is used to drive an ultrasonic transducer directly from a parallel output port. Output frequencies and timing are based on the 4 MHz clock rate of the author's Z80 system.*

```
CROMEMCO CDOS Z80 ASSEMBLER version 02.15
XMIT:   TRANSMIT COMMAND TO HOME CONTROL SYSTEM

                 ; XMIT:         TRANSMIT COMMAND TO HOME CONTROL SYSTEM
                 ;
                 ; PURPOSE:      TO GENERATE THE SIGNALS REQUIRED TO DRIVE AN ULTRASONIC
                 ;               TRANSDUCER TO TRANSMIT COMMANDS TO THE BSR X-10 (OR SEARS)
                 ;               HOME CONTROL SYSTEM
                 ;
                 ; USAGE:        CALL XMIT
                 ;
                 ; WHERE:        HL CONTAINS THE ADDRESS OF THE COMMAND DYTE
                 ;
                 ;       COMMAND BYTE (DECIMAL):
                 ;       ALL OFF   = 1     CH1 = 12    CH7  = 10    CH13 = 0
                 ;       LIGHTS ON = 3     CH2 = 28    CH8  = 26    CH14 = 16
                 ;       ON        = 5     CH3 = 4     CH9  = 14    CH15 = 8
                 ;       OFF       = 7     CH4 = 20    CH10 = 30    CH16 = 24
                 ;       DIM       = 9     CH5 = 2     CH11 = 6
                 ;       BRIGHT    = 11    CH6 = 18    CH12 = 22
                 ;
                         ENTRY   XMIT
                 ;
0000' F5           XMIT:   PUSH    AF;             SAVE REGISTERS
0001' C5                   PUSH    BC
0002' D5                   PUSH    DE
0003' E5                   PUSH    HL
0004' 7E                   LD      A,(HL);         GET THE CODE WORD
0005' 07                   RLCA;                   POSITION THE CODE WORD
0006' 07                   RLCA
0007' 07                   RLCA
0008' 2F                   CPL
0009' 5F                   LD      E,A;            SAVE THE COMPLEMENT FOR LATER USE
000A' 2F                   CPL
                 ;
000B' CD2F00'              CALL    SND1;           TRANSMIT THE START BIT
000E' 1605                 LD      D,5;            SETUP TO TRANSMIT THE NEXT 5 BITS
0010' 07           XLP1:   RLCA;                   SHIFT BIT TO BE TRANSMITTED INTO CARRY
0011' DC2F00'              CALL    C,SND1;         SEND A ONE IF CARRY IS SET
0014' D43D00'              CALL    NC,SND0;        SEND A ZERO IF CARRY IS CLEAR
0017' 15                   DEC     D
0018' 20F6                 JR      NZ,XLP1;        LOOP UNTIL 5 BITS HAVE BEEN SENF
                 ;
001A' 1605                 LD      D,5;            SETUP TO TRANSMIT ANOTHER 5 BITS
001C' 7B                   LD      A,E;            GET THE COMPLEMENTED DATA
001D' 07           XLP2:   RLCA;                   SHIFT BIT TO BE TRANSMITTED INTO CARRY
001E' DC2F00'              CALL    C,SND1;         SEND A ONE IF CARRY IS SET
0021' D43D00'              CALL    NC,SND0;        SEND A ZERO IF CARRY IS CLEAR
0024' 15                   DEC     D
0025' 20F6                 JR      NZ,XLP2;        LOOP UNTIL 5 BITS HAVE BEEN SENT
                 ;
0027' CD4B00'              CALL    TERM;           TRANSMIT THE TERMINATION SEQUENCE
002A' E1                   POP     HL;             RESTORE THE REGISTERS
002B' D1                   POP     DE
002C' C1                   POP     BC
002D' F1                   POP     AF
002E' C9                   RET
                 ; SND1:          SEND (TRANSMIT) A ONE
                 ;
002F' F5           SND1:   PUSH    AF;             SAVE ACCUM
0030' 06A0                 LD      B,160;          4MS OF 40KHZ
0032' CD5C00'              CALL    FORTY;          GENERATE 40KHZ BURST
0035' 21D703               LD      HL,03D7H;       DELAY FACTOR
0038' CD7100'              CALL    DLY;            DELAY REMAINING BIT TIME
003B' F1                   POP     AF;             RESTORE ACCUM
003C' C9                   RET
                 ;
                 ;
                 ; SND0:         SEND (TRANSMIT) A ZERO
                 ;
003D' F5           SND0:   PUSH    AF;             SAVE ACCUM
003E' 0630                 LD      B,48;           1.2MS OF 40KHZ
0040' CD5C00'              CALL    FORTY;          GENERATE 40KHZ BURST
0043' 219506               LD      HL,0695H;       DELAY FACTOR
0046' CD7100'              CALL    DLY;            DELAY REMAINING BIT TIME
0049' F1                   POP     AF;             RESTORE ACCUM
004A' C9                   RET
                 ;
                 ;
                 ; TERM:         TRANSMIT TERMINATION SEQUENCE
                 ;
004B' 1604         TERM:   LD      D,4;            SEND 4 4MS BURSTS OF 40KHZ
004D' 3EA0         TLP1:   LD      A,160;          SETUP FOR 4MS
004F' CD5C00'              CALL    FORTY;          TRANSMIT 40KHZ
0052' 15                   DEC     D
0053' 20F8                 JR      NZ,TLP1;        LOOP FOR 16MS
                 ;
0055' 215C17               LD      HL,175CH;       DELAY FACTOR
0058' CD7100'              CALL    DLY;            DELAY 24MS
005B' C9                   RET
                 ; FORTY:        GENERATE 40KHZ
                 ;
                 ; USAGE:        LD B,VALUE
                 ;               CALL FORTY
                 ;
                 ; WHERE:        B CONTAINS DURATION FACTOR
                 ;
                 ; NOTE:         DURATION = ( 100 * B + 33 ) * 0.25US
                 ;               ( INCLUDES LD & CALL INSTRUCTION TIMES )
                 ;
                 ; MODIFIED:     A, B, C, H, L
                 ;
                 ;
      (0000)       D0:     EQU     0;      OUTPUT DATA FOR ZERO
      (0004)       D1:     EQU     4;      OUTPUT DATA FOR ONE
      (0018)       PORT:   EQU     18H;    OUTPUT PORT
                 ;
                 ;
005C' 3E04         FORTY:  LD      A,D1
005E' D318                 OUT     (PORT),A;       OUTPUT A HIGH
0060' 0E02                 LD      C,2;            DELAY COUNT
0062' 0D           FLP1:   DEC     C
0063' 20FD                 JR      NZ,FLP1;        DELAY BETWEEN OUTPUTS IS 12.5US
                 ;
0065' 3E00                 LD      A,D0;           DATA FOR LOW OUTPUT
0067' D318                 OUT     (PORT),A;       OUTPUT THE DATA
0069' 0E00                 LD      C,0;            DELAY
006B' 0E00                 LD      C,0;            DELAY
006D' 05                   DEC     B
006E' 20EC                 JR      NZ,FORTY;       END OF CYCLE
0070' C9                   RET
                 ;
                 ;
                 ; DLY:          PROGRAMMED DELAY
                 ;
                 ; USAGE:        LD HL,VALUE
                 ;               CALL DLY
                 ;
                 ; WHERE:        HL CONTAINS DELAY FACTOR
```

Listing 1 continued on page 316

Listing 1 continued:

```
                    0130 ;
                    0131 ; NOTE:             DELAY = ( 4107*H + 16*L + 67 ) * 0.25US
                    0132 ;                   ( DELAY INCLUDES LD & CALL INSTRUCTION TIMES )
                    0133 ;
0071' 24            0134 DLY:     INC     H;                  SETUP FOR DELAY LOOP
0072' 2C            0135          INC     L
0073' 2D            0136 DLP:     DEC     L;                  MINOR DELAY LOOP
0074' 20FD          0137          JR      NZ,DLP;             DELAY THE SPECIFIED COUNTS
0076' 25            0138          DEC     H;                  MAJOR DELAY LOOP
0077' 20FA          0139          JR      NZ,DLP;             DELAY THE SPECIFIED COUNTS
0079' C9            0140          RET
                    0141 ;
007A' (0000)        0142          END

Errors              0

Program Length  007A (122)



CROSS REFERENCE LISTING

D0        0104  0115
D1        0105  0109
DLP       0136  0137 0139
DLY       0134  0063 0074 0088
FLP1      0112  0113
FORTY     0109  0061 0072 0083 0120
PORT      0106  0110 0116
SND0      0070  0038 0046
SND1      0059  0034 0037 0045
TERM      0081  0050
TLP1      0082  0085
XLP1      0036  0040
XLP2      0044  0048
XNIT      0020 #0022
```

■

Steve Ciarcia's Comments

My compliments to Alan Trimble on his ingenuity. An ultrasonic transducer tied directly to one line of an output port is a very viable approach. In fact, the first control circuit I designed employed an NE555 timer, used as a tone-burst generator, and an ultrasonic transducer attached as you describe. This additional $0.50 component (the NE555) further reduces the software overhead while maintaining minimum system cost.

When I wrote the article, I made a tough decision. Either I could present a $6 interface designed for use with a computer that has existing output ports, a particular system clock rate, and a particular processor, or I could make the hardware smarter (and more expensive) and yet usable on virtually any computer. With the first alternative, I would have gotten about 200 letters asking how to design a parallel output port; the second was the better way to proceed under the circumstances.

There are often many approaches to the design of an interface. My philosophy is to try to tender the one that has the greatest potential for being implemented by BYTE readers. I'd rather not be remembered for my great theoretical presentations. I depend on intelligent people like Mr Trimble to read between the lines and customize my interfaces to meet their individual system requirements.

Regarding the expense of buying the equipment, I am familiar with only the MicroMint unit (the Busy Box). For the purchase price, you get a unit that is assembled and tested; it includes a case, power supply, and instructions; and it comes with the cables required to plug it in and use it.

Anyone wishing to build Mr Trimble's design for a control interface can get the 40 kHz transducer (part number MM 1002) for $6 postpaid from:

The MicroMint Inc
917 Midway
Woodmere NY 11598
(516) 374-6793

My thanks to Mr Trimble for pointing out this approach to interface design.... **Steve Ciarcia**

Power AND Flexibility for the HEATH® H8

D-G Electronic Developments Co. introduces NEW Hardware, Firmware, and Software support for the H8. Combined with the already popular DG-80 CPU, our products provide an ever increasing line of complimentary support devices to enhance the power and flexibility of the H8 Computer.

INTRODUCING: the DG-64D

- Up to 64K bytes capacity Dynamic RAM
- Hardware bank selectable in 8K increments
- Software bank selectable in 16K increments through I/O port
- On-board bank select/CPU ROM disable port, addressable to any 256 I/O addresses
- Up to 8 boards controllable through one I/O port (allows page mode operation)
- On-board transparent refresh for 8080 or Z80 microprocessor backed up by asynchronous refresh upon loss of normal program execution
- 4 MHz operation with no wait states required
- Low power consumption
- Assembled, tested, & burned-in—90 day warranty

Prices:

64K	**529.00**
48K	**480.00**
32K	**431.00**
16K	**382.00**
ØK	**333.00**
Documentation only (DG-64D)	**15.00**

STATE OF THE ART CPU FOR THE HEATH® H8

DG-80 Z80® CPU—249.00 (Assembled & Tested) Documentation only: $25.00

NEW—SUPPORT for the DG-80

the DG-FP8

Monitor/Utility package for use with the DG-80 CPU which provides functions of PAM-8 as well as the following:

- Z80 monitor features such as display alternate register sets, display index registers, etc.
- "Shorthand" modes for display of memory contents pointed to by general purpose registers
- Supports STANDARD CP/M provided by D-G Electronic Developments Co. as well as HDOS
- Provides firmware support for DG-ADP4, 4MHz hardware

the DG-ADP4

Plug-in hardware modification to allow operation of the Heath H17 disk system with the DG-80 at 4 MHz. Requires the use of the DG-FP8 firmware package.

STANDARD CP/M® Ver. 2.2

16K CHIP SETS (8-4116 Type Dynamic RAMS) for DG-32D, Apple®, TRS-80®, H88/89® and PET® (Tested) ... **$49.00**

NEW PRICING ON OUR POPULAR DG-32D (32K Dynamic RAM for Heath H8)

32K	339.00	ØK	235.00
16K(½ populated)	280.00	Documentation only	12.00

CP/M is a registered trademark of Digital Research of Pacific Grove, California. Heath, HDOS, H8, H88/89 & PAM8 are registered trademarks of the Heath Company. Z80 is a registered trademark of Zilog Corp. PET is a registered trademark of Commodore. Apple is a registered trademark of Apple Computer. TRS-80 is a registered trademark of TANDY Corp.



Ordering Information: Products listed available from DG Electronic Developments Co., P.O. Box 1124, 1827 South Armstrong, Denison, Tx. 75020. Check, Money Order, VISA or Master Charge accepted. Phone orders (charge only) call (214) 465-7805. No COD's. Freight prepaid. Allow 3 weeks for personal checks to clear. Texas residents add 5%. Foreign orders add 30%. Prices subject to change without notice.

Circle 357 on inquiry card.



A Message to our Subscribers

From time to time we make the BYTE subscriber list available to other companies who wish to send our subscribers promotional material about their products. We take great care to screen these companies, choosing only those who are reputable, and whose products, services, or information we feel would be of interest to you. Direct mail is an efficient medium for presenting the latest personal computer goods and services to our subscribers.

Many BYTE subscribers appreciate this controlled use of our mailing list, and look forward to finding information of interest to them in the mail. Used are our subscribers' names and addresses only (no other information we may have is ever given).

While we believe the distribution of this information is of benefit to our subscribers, we firmly respect the wishes of any subscriber who does not want to receive such promotional literature. Should you wish to restrict the use of your name, simply send your request to BYTE Publications Inc, Attn: Circulation Department, 70 Main St, Peterborough NH 03458. Thank you.

More on Skip Chains

Mark S Williamsen, 3114 Central St, Evanston IL 60201

In regards to Geoffrey Gass's Technical Forum "Mining the Skip Chain" (February 1980 BYTE, page 148), I would like to add an alternative which has several advantages: a lookup table. A skip chain in its simplest form (testing a single byte to access routines located within a single page [256 bytes] of memory) uses a minimum of 4 bytes of 6800-microprocessor code per test. If the skip chain is to call routines outside of that one page, then 7 bytes are required for each comparison. (See listings 1 and 2.)

On the other hand, a lookup table needs a search routine (as in listing 3) of about 25 bytes and 3 additional bytes for each entry in the table if extended addressing is used. The break-even point is about 6 comparisons. Beyond that, the lookup table scheme uses less memory. It has the additional advantage that the program does not have to be reassembled to add new entries. In fact, if an end-of-table trap is used, as in listing 3, new entries can be written into a programmable read-only memory (PROM) without changing or erasing any previous data. This is ideal for use in a PROM monitor because new commands and routines can be added at any time if blank space is left following the table. ■

Listing 1

```
                        NAM     SKIPCH
                *SIMPLEST FORM SKIP CHAIN ROUTINE
                *GOES TO ONE OF SEVERAL ROUTINES
                 DEPENDING ON
                *CONTENTS OF ACC. B
                *M, WILLIAMSEN 1/31/'80
                *DEFINITON OF DUMMY LABELS TO
                 SATISFY ASSEMBLER;
      FF00      INCH    EQU     $FF00
      0000      C1      EQU     0
      0000      C2      EQU     0
      0000      C3      EQU     0
      0000      R1      EQU     0
      0000      R2      EQU     0
      0000      R3      EQU     0
0000  BDFF00    START   JSR     INCH    GET
                                        CHARACTER IN
                                        ACC. B
0003  C100      FIRST   CMP B   #C1     B=CODE 1?
0005  27 F9             BEQ     R1      IF YES, GO TO
                                        ROUTINE 1
0007  C100      SEC     CMP B   #C2     B=CODE 2?
0009  27 F5             BEQ     R2      IF YES, GO TO
                                        ROUTINE 2
000B  C1 00     THIRD   CMP B   #C2     B=CODE 3?
000D  27 F1             BEQ     R3      IF YES, GO TO
                                        ROUTINE 3
                *
                *
                *
                *FURTHER COMPARISONS AS
                 NECESSARY
                *
                *
                *
```

Listing 1 continued on page 319

Listing 1 continued:

```
000F  20 EF              BRA    START  GET NEW INPUT
                                       IF
                         END           CODE NOT
                                       FOUND

TOTAL ERRORS 00000
```

Listing 2

```
                         NAM    SKIPEX
                   *SKIP CHAIN ROUTINE WITH EXTENDED
                   ADDRESSING
                   *GOES TO ONE OF SEVERAL ROUTINES
                   DEPENDING ON
                   *CONTENTS OF ACC. B
                   *M. WILLIAMSEN 1/31/'80
                   *DEFINITON OF DUMMY LABELS TO
                   SATISFY ASSEMBLER;
            FF00   INCH  EQU    $FF00
            0000   C1    EQU    0
            0000   C2    EQU    0
            0000   C3    EQU    0
            0000   CN    EQU    0
            0000   R1    EQU    0
            0000   R2    EQU    0
            0000   R3    EQU    0
            0000   RN    EQU    0
      0000  BDFF00 START JSR    INCH   GET
                                       CHARACTER IN
                                       ACC. B
      0003  C1 00  FIRST CMP B  #C1    B=CODE 1?
      0005  26 03        BNE    SEC    CONTINUE IF NO
      0007  7E 0000      JMP    R1     GO TO ROUTINE
                                       1 IF YES
      000A  C1 00  SEC   CMP B  #C2    B=CODE 2?
      000C  26 03        BNE    THIRD  CONTINUE IF NO
      000E  7E 0000      JMP    R2     GO TO ROUTINE
                                       2 IF YES
      0011  C1 00  THIRD CMP B  #C2    B=CODE 3?
      0013  26 03        BNE    NTH    CONTINUE IF NO
      0015  7E 0000      JMP    R3     GO TO ROUTINE
                                       3 IF YES
                   *
                   *
                   *
                   *FURTHER COMPARISONS AS
                   NECESSARY
                   *
                   *
                   *
      0018  C1 00  NTH   CMP B  #CN    B=CODE N?
      001A  26 E4        BNE    START  GET NEW INPUT
                                       IF NO
      001C  7E 0000      JMP    RN     GO TO ROUTINE
                                       N IF YES
                         END

TOTAL ERRORS 00000
```

Listing 3

```
                         NAM    LOOKUP
                   *COMMAND DECODER WITH LOOKUP
                   TABLE.
                   *GOES TO ONE OF SEVERAL ROUTINES
                   DEPENDING ON
                   *CONTENTS OF ACC. B
                   *M. WILLIAMSEN 1/31/'80
                   *DEFINITON OF DUMMY LABELS TO
                   SATISFY ASSEMBLER;
            FF00   INCH  EQU    $FF00
            0000   C1    EQU    0
            0000   C2    EQU    0
            0000   C3    EQU    0
            0000   CN    EQU    0
            0000   R1    EQU    0
            0000   R2    EQU    0
            0000   R3    EQU    0
            0000   RN    EQU    0
      0000  BD FF00 START JSR   INCH   GET
                                       CHARACTER IN
                                       ACC. B
      0003  CE 0018      LDX    #TABLE INITIALIZE
                                       POINTER.
```

Listing 3 continued on page 320

Circle 249 on inquiry card.

Circle 250 on inquiry card.

Listing 3 continued:

```
0006  A600    GC1    LDA A  X      GET CODE FROM
                                   TABLE.
0008  08             INX           INCREMENT
                                   POINTER.
0009  81 FF          CMP A  #$FF   IF END OF TABLE
000B  27 F3          BEQ    START  GET NEW INPUT.
000D  11             CBA           DOES ACC,
                                   B=CODE?
000E  27 04          BEQ    FOUND  IF YES, GO TO
                                   ROUTINE.
0010  08      NEXT   INX           INCREMENT
                                   POINTER TO
0011  08             INX           NEXT CODE IN
                                   TABLE
0012  20 F2          BRA    GC1    IF NO.
0014  EE 00   FOUND  LDX    X      LOAD POINTER
                                   FROM TABLE
0016  6E 00          JMP    X      AND GO TO
                                   ROUTINE,
              *LOOKUP TABLE STARTS HERE:
0018  00      TABLE  FCB    C1     CODE 1
0019  0000           FDB    R1     ADDRESS OF
                                   ROUTINE 1
001B  00             FCB    C2     CODE 2
001C  0000           FDB    R2     ADDRESS OF
                                   ROUTINE 2
001E  00             FCB    C3     CODE 3
001F  0000           FDB    R3     ADDRESS OF
                                   ROUTINE 3
              *
              *
              *
              *FURTHER TABLE ENTRIES AS
              NECESSARY
              *
              *
              *
0021  00             FCB    CN     CODE N
0022  0000           FDB    RN     ADDRESS OF
                                   ROUTINE N
                     END

TOTAL ERRORS 00000
```


Beware of Interrupts

Dave Feldman, 1856 Viking Way, La Jolla CA 92037

I have read with interest Michael McQuade's article "A Fast, Multibyte Binary to Binary-Coded-Decimal Conversion Routine" (February 1980 BYTE, page 106).

I wish to make the following comment regarding the program presented in listing 1, on page 110.

If the program is run in an environment in which interrupts exist, the user may experience difficulty in obtaining correct results should an interrupt occur when execution is just before RLOOP or just after LAB17 (in the area of the DCX SP instructions). The data on the stack (which is "recovered" by use of the two DCX SP instructions) will be overwritten by the return address saved when execution is transferred to the interrupt service routine. To prevent this problem, replace each occurrence of DCX SP DCX SP with a PUSH H or keep interrupts off while the subroutine is executing. I recommend the former. ■

Technical Forum is a feature intended as an interactive dialog on the technology of personal computing. The subject matter is open-ended, and the intent is to foster discussion and communication among readers of BYTE. We ask that all correspondents supply their full names and addresses to be printed with their commentaries. We also ask that correspondents supply their telephone numbers, which will not be printed.

Bending BASIC in a Recursive Form

Colin Newell, Newcastle, Australia

I read Stanley Swizer's "The Towers of Hanoi: Solution Using BASIC Recursion" ("Programming Quickies," March 1980 BYTE, page 240) with interest. He has shown us how to solve this problem in BASIC; however, my BASIC does not incorporate a stack. So here is my way of solving this problem (listing 1).

Listing 1

```
10  INPUT "NO OF DISKS ";N
20  LET I = 1
30  LET J = 3
40  GOSUB 100
50  GOTO 300
100  IF N = 0 THEN RETURN
110  LET N = N - 1
120  LET J = 6 - I - J
130  GOSUB 100
140  LET J = 6 - I - J
150  PRINT "MOVE TOP DISK ON TOWER ";I;" TO TOWER "; J
160  LET I = 6 - I - J
170  GOSUB 100
180  LET I = 6 - I - J
190  LET N = N + 1
200  RETURN
300  END

READY

RUN
NO OF DISKS ? 3
MOVE TOP DISK ON TOWER 1 TO TOWER 3
MOVE TOP DISK ON TOWER 1 TO TOWER 2
MOVE TOP DISK ON TOWER 3 TO TOWER 2
MOVE TOP DISK ON TOWER 1 TO TOWER 3
MOVE TOP DISK ON TOWER 2 TO TOWER 1
MOVE TOP DISK ON TOWER 2 TO TOWER 3
MOVE TOP DISK ON TOWER 1 TO TOWER 3
```

Programming in the Dark

Jeffrey Sainio, 143 N Moreland #106, Waukesha WI 53186

Robert Glaser's article on programming 2708-type read-only memories ("Program Those 2708s," April 1980 BYTE, page 198) is a boon to those of us who are interested in programmer boards with three-figure price tags. Having built a similar board, let me offer some pointers I have learned:

- 2708s program faster in the dark. This holds true for the devices manufactured by Intel, Texas Instruments, and Motorola that I have used. The speed difference between total darkness and bright incandescent light is over ten to one. The devices also read 0s more easily in the dark (ie: a marginally programmed bit may read correctly in the dark, but not in the light).
- Programming can be done interactively. By pulling the +26 V and CS (chip select) lines low, a byte of information can be read through an input port. If a logical exclusive-OR of the original data and the read data yields all 0s the byte does not need programming. The result of the exclusive-OR may be inverted and ORed with the desired data, then tested. If the result is anything other than hexadecimal FF, the device should be erased. If a programming pulse is to be applied, remember to set CS at +12 V before applying the +12 V; and remember that +26 V must be *turned off* before reading the device.

By using these techniques, I can program a 2708 in three to fifteen seconds. After an entire programming loop has been executed with no false bits indicated, I shine a high-intensity lamp through the device's window to catch any marginal bits. This ensures that all bits are programmed solidly.

Having used this programming technique on devices rated at 450 ns installed in a Z80 system (running at 4 MHz with no WAIT states), I can say that the method may not seem "kosher," but it is fast and error-free. ■

6502 Loop Control

Gordon Campbell, 36 Doubletree Rd, Willowdale, Ontario, Canada

For clarity, the best way to loop through a field is to start at the beginning and stop at the end. It is important to be able to change the content or length of the field without having to change the code that handles it. Some people use a *marker byte* such as hexadecimal 00 to stop the loop; however, if you make your assembler work for you, this is unnecessary.

Listing 1 is an example of how to make your assembler perform this task. The X register is used to index through a field. The code is set up so that when the register hits zero, execution is terminated. Thus, begin by loading the register with 256 minus the length of the field. Then work through the field from start to end by loading the accumulator with the byte stored at the end of the message minus 256, plus the contents of the X register. The result is that when the X register hits zero, you are done.

The code shown has been used with two assemblers: Carl Moser's ASSM/TED, and Dan Fylstra's *6502 Assembler in BASIC*, published by Personal Software. Fylstra's assembler generates an error message on the first pass if MSG and MSGEND follow the code that uses them, but then produces correct object code. Of greater concern is the fact that both assemblers do not notice if MSG is greater than 256 bytes long. This should be an error condition that raises a diagnostic. In both cases the only result is that incorrect code is produced.

```
                   0010             .BA $7000
                   0020             .OS
                   0030             .LS
                   0040 ; ** HOW TO SCAN A FIELD **
                   0050 ; (MAKE YOUR ASSEMBLER WORK)
                   0060 ;
                   0070 ; THE OPTIMUM METHOD OF LOOP
                   0080 ; CONTROL ON A 6502. MAXIMUM
                   0090 ; OF 256 BYTES OF DATA.
                   0100 ;
                   0110 ;           .
                   0120 ;           .
                   0130 ;           .
                   0140 ;           .
7000- A2 F1        0150             LDX #MSG+256-MSGEND
7002- BD 1B 6F     0160 PRLOOP      LDA MSGEND-256,X
7005- 20 D2 FF     0170             JSR PRINT
7008- E8           0180             INX
7009- D0 F7        0190             BNE PRLOOP
                   0200 ;           .
                   0210 ;           .
                   0220 ;           .
700B- 00           0230             BRK
                   0240 ;
700C- 50 4C 45     0250 MSG         .BY 'PLEASE PRINT ME'
700F- 41 53 45
7012- 20 50 52
7015- 49 4E 54
7018- 20 4D 45
                   0260 MSGEND
                   0270 ;
                   0280 PRINT       .DE $FFD2
                   0290             .EN

LABEL FILE:  [ / = EXTERNAL ]


PRLOOP=7002           MSG=700C        MSGEND=701B
/PRINT=FFD2
//0000,701B,701B
>
```

Sorting With a Catch

Paul T Brady, 91 Marcshire Dr, Middletown NJ 07748

So much has been said concerning various sorting algorithms that it hardly seems possible to be able to contribute to this topic; and yet, in a small business (a nature

center, to be precise), we have developed a sorting routine that handles accounting entries, mailing list entries, etc, at a speed that leaves fancy algorithms in the dust. The special beauty of this technique is that it is very simple, and involves only a slight modification of the usually terribly inefficient brute-force *bubble* technique.

The routine has another advantage—it will not disturb the order of ties. For example, if one orders by zip code, it will not rearrange entries having the same zip code. This is an advantage if the list were previously alphabetized and you wanted to retain alphabetization within zip codes.

There is a catch. This routine is absolutely terrible for ordering a true random list. The routine is designed to handle a list that already is nearly in order, and you want to add a few extra items. But this is exactly the case in a mailing list, in which you add 20 names to a 1500-name list, or in accounting, in which you add 15 transactions to a 60-item list.

The Algorithm

The algorithm works as follows: assume that you have an array of L items, A(I), I = 1 to L. In the standard bubble sort, you compare A(1) with A(2). Assume that you want the list ordered from smallest to largest entry. Then, if A(1) < = A(2), leave them alone, but if A(1) > A(2), reverse them and proceed pairwise down the list. The last comparison made is between A(L−1) and A(L), reversing them if A(L−1) > A(L). You have just made L−1 pairwise comparisons.

For those unfamiliar with this method, a moment's thought should demonstrate that in this first pass you have guaranteed that the largest entry has sunk to the bottom. That is, A(L) now is the largest entry. In subsequent passes, it is no longer necessary to test anything against A(L). So, the second pass ends by comparing A(L−2) with A(L−1). But now, you have guaranteed that the second biggest entry is in the L−1 slot, so each successive pass requires one less comparison.

Even with the shortcut of cutting each pass to be one shorter than the previous pass, this method still takes a long time. But now consider the following. Suppose, during the first pass of L−1 comparisons, we check to see just how well ordered the list already is. We will set up a *window* in which W equals the first pair that was ordered, and X equals the last pair. Suppose the list contains 85 items, but after the first pass, W = 26 and X = 34. This means that everything beyond 34 is already ordered. Items earlier than 26 may not be completely in order when considering later items, but the very next pass can compare entry twenty-five with entry twenty-six; ie: at W−1. So, we have a window that will ascend to the top of the list. Further, on each successive pass we will reevaluate W and X. As soon as X < = 1, we can stop. (Note: X can equal zero in the special case that the entire list was already in order before you invoked the routine.)

The Program

This idea is so simple that it cannot be new; yet, I have not seen it mentioned, and even if it is published elsewhere, it is worth repeating. The code in listing 1 is for North Star BASIC, in which the semicolon separates statements on the same line. W and X have already been defined. T, T1, and T2 are temporary variables. I is an index variable, and A(I) is the array. The A(I) could also be pointers to string variables; the technique is clearly not limited to ordering numbers.

A final comment. This routine is at its very best if the list is already completely ordered before calling it; it makes one pass through the list, discovers that the list is already ordered (X=0 in statement 135), and quits. This is not at all a ridiculous situation. We have several programs that require ordered data in files, and call the sort routine whenever a "write" is called for, even if nothing was done to disturb the order. In such instances, the sort is only a momentary delay.

Listing 1: *A bubble sort with a window. This routine is designed specifically to sort lists with only a few entries out of order. It can even be used to check a list quickly to ensure that all entries are ordered. The main attraction, though, is its simplicity; the actual North Star BASIC code is only eight lines long.*

```
100 W=2;X=L;REM W=UPPER WINDOW BOUND, X=LOWER
105 FOR I=1 TO L
110 T1=X;X=0;IF W<2 THEN W=2;T2=W-1;W=0
115 FOR J=T2 TO T1-1;REM BEGIN AT T2. STMT 110
    ASSURES T2 >=1.
120 IF A(I) <= A(I+1) THEN 135
125 T=A(I);A(I)=A(I+1):A(I+1)=T;REM. OUT OF ORDER,
    REVERSE.
130 X=J;IF W=0 THEN W=J; REM W=0 IMPLIES FIRST
    REVERSAL.
135 NEXT;IF X <= 1 THEN EXIT 145;NEXT
140 STOP;REM FOR COMMENT ONLY - WILL NEVER BE
    REACHED.
141 REM WILL NEVER FINISH SECOND "NEXT" OF 135
145 REM ROUTINE ENDS HERE, LIST IS ORDERED.
```
■

Programming Quickies

Notes on Absolute Location Interfaces to Apple Pascal

Daniel D Sokol, 211 Fall Creek Dr, Felton CA 95018

After seeing the March 1980 BYTE Editorial ("Hunting the Computerized Eclipse," page 6), I realized that many other users of Apple Pascal have encountered the same problem I have: the difficulty in accessing memory locations directly. I have written two programs that help to minimize this problem.

Listing 1: *A UCSD Pascal compilation unit called PEEKPOKE which provides the modules PEEK and POKE that allow access to arbitrary memory locations. Care should be exercised in using this routine, because data vital to the operating system may be inadvertently modified.*

```
(*$S+,LPRINTER:*)

(************************************          This program has been designed
 *                                  *          to be added to the Pascal
 *        PEEK and POKE             *          SYSTEM.LIBRARY. See section
 *                                  *          4.2 in the reference manual
 *     Dan Sokol     3 Dec 79       *          for info on the Librarian.
 *                                  *
 ************************************)

unit PEEKPOKE; intrinsic code 26;              (* I used segment 26 *)

interface

procedure POKE(var ADDR,DATA:integer);         (* Format is :           *)
function PEEK(var ADDR:integer):integer;       (* POKE(addr,data);      *)
                                               (* data:=PEEK(addr);

                                                  Both addr and data
                                                  must be INTEGER variables
                                                  (not constants)

                                                  To use in a program you
                                                  must follow the program
                                                  name with :
                                                  USES PEEKPOKE;
                                                                        *)

implementation

type PA = packed array[0..1] of 0..255;        (* this defines a variant *)
     MAGIC = record case boolean of            (* record which will map  *)
             true : (INT: integer);            (* to an absolute hardware *)
             false : (PTR:^PA);                (* address in the Apple.   *)
             end;

var CHEAT:MAGIC;


procedure TEST(var DATA:integer); forward;


procedure POKE;
  begin
   TEST(DATA);
   CHEAT.INT:=ADDR;
   CHEAT.PTR^[0]:=DATA;
  end;

function PEEK;
  begin
   CHEAT.INT:=ADDR;
   PEEK:=CHEAT.PTR^[0];
  end;



procedure TEST;                                (* This procedure assures *)
  begin                                        (* only valid data will   *)
   DATA:=abs(DATA mod 256);                    (* get poked *)
  end;



(* MAIN PROGRAM *)

begin
(* DUMMY PROGRAM *)
end.
```

The first program, entitled UNIT.PEEK.TEXT (shown in listing 1), is a library *intrinsic* that performs the same functions as PEEK and POKE in BASIC. It uses the variant-record technique to access arbitrary addresses in memory.

The second program is called CALL.ASSY.TEXT (shown in listing 2). It is an assembly-language linkage which allows the user to call, from a Pascal routine, an external (non-Pascal) assembly-language program at an arbitrary address in memory. It is, of course, possible to call an assembly-language module that is linked into a Pascal program, such as this module itself, but the linker has no provision for fixing an absolute address of the called routine. Thus this routine is required as an escape to routines found at locations fixed by hardware, such as the read-only memory regions of the typical Apple input/output (I/O) cards.

Listing 2: *CALL, a UCSD Pascal system assembly-language program for a 6502 processor. This routine will call an arbitrary absolute address, such as an address associated with a read-only memory routine in an interface card, which is not normally accessible from Pascal. As in listing 1, care should be exercised in using this routine.*

```
;
; PROGRAM TO CREATE A CALL FUNCTION FOR PASCAL IN THE APPLE;
;
; Use this assembly lanquge program to call programs
; that are not normally accessable from Pascal.
;
; To use: ASSEMBLE this program and save the code file.
;         Define a PROCEDURE in your program as follows -
;               PROCEDURE CALL(addr); EXTERNAL;
;         addr must be an integer variable.
;
;         Compile your program and then run the linker.
;         When asked for the LIB.name type the name of the save code file.
;
; WARNING : ANY PROGRAM THAT CHANGES MEMORY LOCATIONS MAY INTERFERE WITH
;           THE PASCAL OPERATING SYSTEM.
;


        .TITLE " CALL SUBR - 15 FEB 80 - DAN SOKOL"

        .MACRO POP
        PLA
        STA     %1
        PLA
        STA     %1+1
        .ENDM

        .MACRO PUSH
        LDA     %1+1
        PHA
        LDA     %1
        PHA
        .ENDM

         PROC CALL,1
;
;       procedure CALL(ADDR:integer); external;
;


RETURN  .EQU    0
MYCALL  .EQU    2



         POP     RETURN  ; SAVE PASCAL RETURN ADDR;
#        PLA
#        STA     RETURN
#        PLA
#        STA     RETURN+1
         POP     MYCALL  ; SAVE OUR CALLING ADDR ;
#        PLA
#        STA     MYCALL
#        PLA
#        STA     MYCALL+1
         PUSH    RETURN  ; PUT BACK ON STACK;
#        LDA     RETURN+1
#        PHA
#        LDA     RETURN
#        PHA
         JMP    @MYCALL  ; JUMP TO USER PROGRAM

         .END        ■
```

A Lowercase-to-Uppercase Converter

Roger L Degler
Motorola Inc
Mail Drop M2 90
2200 W Broadway
Mesa AZ 85202

Many ASCII-encoded keyboards are capable of generating both uppercase and lowercase codes. Many of these contain a jumper option that will disable the lowercase characters, and generate their uppercase counterparts. But some keyboards do not offer this option, and trying to use an uppercase/lowercase keyboard on a system that requires only uppercase characters becomes very frustrating. Of course, the uppercase codes may be generated singly by pressing the shift key.

The problem with this is trying to remember to press the shift key every time you want to enter an uppercase letter and to leave it unpressed when you want to enter a number or lowercase symbol. Mistakes are inevitable. However, there are two possible solutions: convert the lowercase characters to uppercase with additional software in the character input routine; or perform the conversion with a hardware circuit between the keyboard and the computer.

The software approach is the better alternative. The software, shown in listing 1, is extremely simple and can be as versatile as the user desires it to be. For example, by setting or clearing a software-flag location, the lowercase characters may be enabled or disabled. This assumes that the user has access to the computer's character-input routine and that the routine can be modified.

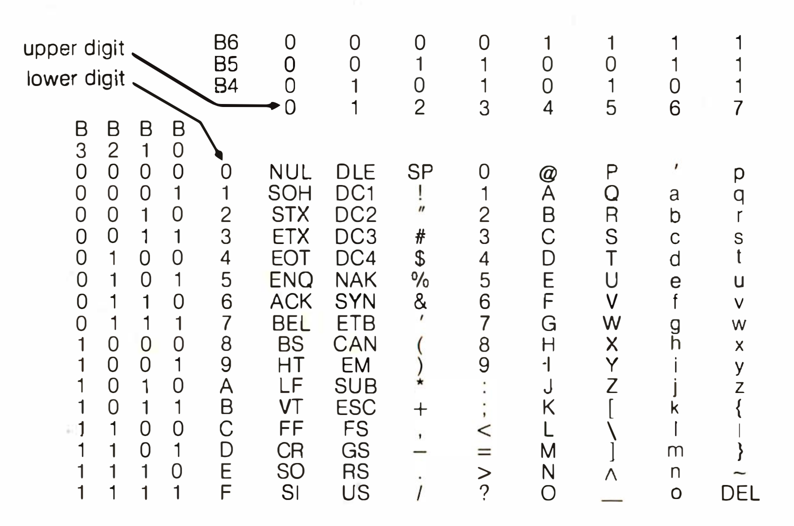
The hardware conversion method, on the other hand, is somewhat less versatile and requires more effort to implement. Versatility is lost because alternation between the two modes, that is, allowing and disallowing lowercase, requires the physical act of

Listing 1: *Software routine to convert from lowercase to uppercase ASCII (American Standard Code for Information Interchange). This routine is relocatable to any address in memory. It assumes that the character to be converted resides in the accumulator; the result is left in the accumulator. The routine is written for the 6800 microprocessor and requires only 13 bytes.*

Hexadecimal Address	Hexadecimal Code	Label	Instruction Mnemonic	Operand	Commentary
0100	84 7F	CNVT	ANDA	#$7F	Mask to 7 bits.
0102	81 61		CMPA	#$61	Check for lowercase.
0104	2D 06		BLT	NOCNVT	Do not convert if not.
0106	81 7A		CMPA	#$7A	Do not convert special characters
0108	2E 02		BGT	NOCNVT	at end of ASCII code table.
010A	8A 5F		ANDA	#$5F	Convert to uppercase.
010C	39	NOCNVT	RTS		Return.

Number	Type	+5 V	GND
IC1	MC14585	16	8
IC2	MC14585	16	8
IC3	MC14011	14	7
IC4	MC14001	14	7

Figure 1: *Schematic diagram for the lowercase/uppercase hardware interface. This circuit assumes that there is a parallel interface between the keyboard and the microcomputer. All integrated circuits are complementary metal-oxide semiconductor (CMOS) types for low power consumption. IC1 and IC2 are 4-bit comparators. Switch SW1 transfers the keyboard between an uppercase-only mode and a mixed uppercase-and-lowercase mode. These two modes are achieved with SW1 closed and opened, respectively.*



				B6	0	0	0	0	1	1	1	1
				B5	0	0	1	1	0	0	1	1
				B4	0	1	0	1	0	1	0	1
B3	B2	B1	B0	lower digit / upper digit	0	1	2	3	4	5	6	7
0	0	0	0	0	NUL	DLE	SP	0	@	P	'	p
0	0	0	1	1	SOH	DC1	!	1	A	Q	a	q
0	0	1	0	2	STX	DC2	"	2	B	R	b	r
0	0	1	1	3	ETX	DC3	#	3	C	S	c	s
0	1	0	0	4	EOT	DC4	$	4	D	T	d	t
0	1	0	1	5	ENQ	NAK	%	5	E	U	e	u
0	1	1	0	6	ACK	SYN	&	6	F	V	f	v
0	1	1	1	7	BEL	ETB	'	7	G	W	g	w
1	0	0	0	8	BS	CAN	(	8	H	X	h	x
1	0	0	1	9	HT	EM	)	9	I	Y	i	y
1	0	1	0	A	LF	SUB	*	:	J	Z	j	z
1	0	1	1	B	VT	ESC	+	;	K	[	k	{
1	1	0	0	C	FF	FS	,	<	L	\	l	|
1	1	0	1	D	CR	GS	–	=	M	]	m	}
1	1	1	0	E	SO	RS	.	>	N	∧	n	~
1	1	1	1	F	SI	US	/	?	O	_	o	DEL

Figure 2: *ASCII code table. When converting from lowercase to uppercase, by either hardware or software, only hexadecimal codes 61 thru 7A should be changed. The change to uppercase is made by setting bit B5 to 0 or, equivalently, by subtracting hexadecimal 20 from the code. All other codes should be left intact.*

flipping a switch. Thus, a program calling for large quantities of both uppercase and lowercase input will be inconvenient to run. But this should be no more trouble than shifting on a regular typewriter. In any case, hardware design should be kept as simple as possible.

The circuit in figure 1 meets these desirable requirements. Once constructed, it is connected between the keyboard and the computer. It will convert the lowercase letters "a" through "z" into their uppercase equivalents if switch SW1 is closed. If SW1 is open, all codes, whether uppercase or lowercase, are passed directly to the interface. Construction is noncritical, and very little power is needed due to the use of CMOS integrated circuits. ■

A BASIC Floppy-Disk Accounting System

```
10 DIMB(19),I(2,19,11),T$(440),D$(33)
20T$(  1, 55)='CASH       SECURITIES RECEIVABLESINVENTORY  OTHER      '
30T$( 56,110)='PLANT      MACHINERY  EQUIPMENT  RAW STOCK  OTHER      '
40T$(111,165)='PAYABLES   TAXS PAY.  LOANS PAY. OTHER PAY. DEBENTURES '
50T$(166,220)='LT LOANS   NOTES      OTHER LT   STOCK $1PARR. EARNINGS'
60T$(221,275)='SERV. FEES ROYALTIES  ASSETS SOLDSOFTWARE   OTHER SALES'
70T$(276,330)='INVENTORY  ASSETS SOLDDEPRECIAT. OTHER      OTHER      '
80T$(331,385)='RENT       ELECTRIC   GAS        TELEPHONE  PUBLICATION'
90T$(386,440)='SUPPLIES   POSTAGE    TRANSPORT. SALARIES   OTHER      '
100 !'BALANCE SHEET ACCOUNTS == INCOME STATEMENT ACCOUNTS'
110 !'====================================================='
120 FORA=0TO19\B=A+20\T1=A\GOSUB1200\T2=T1\T1=B\GOSUB1200
130 !%5I,A,'  ',T$(T2-10,T2),'     == ',%5I,B,'  ',T$(T1-10,T1)\NEXT
140 INPUT' 0 TO END OR 1 TO ERASE A FILE ? ',A\IFA=0THENEND
150 GOSUB1000\GOSUB1300\!F$,' HAS BEEN ERASED'\END
1000 INPUT'FILE : ',F$\OPEN#0,F$\RETURN
1100 FORA=0TO19\READ#0,B(A)\NEXT
1110 FORA=0TO2\FORB=0TO19\FORC=0TO11
1120 READ#0,I(A,B,C)\NEXT\NEXT\NEXT\CLOSE#0\RETURN
1200 T1=(T1+1)*11\RETURN
1300 FORA=0TO19\WRITE#0,B(A)\NEXT
1310 FORA=0TO2\FORB=0TO19\FORC=0TO11
1320 WRITE#0,I(A,B,C)\NEXT\NEXT\NEXT\CLOSE#0\RETURN
READY
```

Listing 1: LIST1, a program designed to display the codes used in the author's floppy disk based accounting system. The program also allows the user to erase all data from a given file name. LIST1 is used in the article example to keep track of the business transactions of the JJR Company, a fictitious organization.

```
BALANCE SHEET ACCOUNTS == INCOME STATEMENT ACCOUNTS
=====================================================
    0  CASH            ==     20  SERV. FEES
    1  SECURITIES      ==     21  ROYALTIES
    2  RECEIVABLES     ==     22  ASSETS SOLD
    3  INVENTORY       ==     23  SOFTWARE
    4  OTHER           ==     24  OTHER SALES
    5  PLANT           ==     25  INVENTORY
    6  MACHINERY       ==     26  ASSETS SOLD
    7  EQUIPMENT       ==     27  DEPRECIAT.
    8  RAW STOCK       ==     28  OTHER
    9  OTHER           ==     29  OTHER
   10  PAYABLES        ==     30  RENT
   11  TAXS PAY.       ==     31  ELECTRIC
   12  LOANS PAY.      ==     32  GAS
   13  OTHER PAY.      ==     33  TELEPHONE
   14  DEBENTURES      ==     34  PUBLICATION
   15  LT LOANS        ==     35  SUPPLIES
   16  NOTES           ==     36  POSTAGE
   17  OTHER LT        ==     37  TRANSPORT.
   18  STOCK $1PAR     ==     38  SALARIES
   19  R. EARNINGS     ==     39  OTHER
 0 TO END OR 1 TO ERASE A FILE ? BUD
 INPUT ERROR-RETYPE
 0 TO END OR 1 TO ERASE A FILE ? 1
FILE : BUD
BUD HAS BEEN ERASED
READY
```

Listing 2: A sample run of LIST1, showing codes used for the balance sheet accounts and income statement accounts.

Joseph J Roehrig
JJR Data Research
POB 74
Middle Village NY 11379

The purpose of this article is to present a complete accounting system for a microprocessor equipped with a floppy disk or another storage device. This article gives complete listings for all programs and focuses on the operation rather than on the design of the system. The programs are written in North Star BASIC on an IMSAI 8080 system with 24 K of programmable memory.

As a model we use a fictitious company (JJR) that used the Micro Accounting System in 1976. During this period the journal entry, balance sheet, budget input and general list programs are introduced. Income statement and budget programs are examined later in the article. The magnitude of the figures used and the number of inputs shown are kept to a minimum for the sake of clarity.

In order to design an accounting system, one must decide how many accounts to handle. The system being presented has 20 balance sheet accounts and 20 income statement accounts. The computer automatically clears out all income statement items to retained earnings. For the 20 balance sheet items, only a year-to-date figure is maintained. However, all income statement items are broken down into three possible departments:

- 0 – Administration
- 1 – Local Sales
- 2 – National Sales

Furthermore, monthly activity is tracked for each income statement item. A file contains only one year's worth of data.

The North Star Microfloppy Disk I used has a capacity of 35 tracks. Each track con-

```
10 DIMB(19),I(2,19,11),T$(440),D$(33)
15 DIM J(100,4)
20T$(  1, 55)="CASH          SECURITIES RECEIVABLESINVENTORY  OTHER       "
30T$( 56,110)="PLANT         MACHINERY  EQUIPMENT  RAW STOCK  OTHER       "
40T$(111,165)="PAYABLES      TAXS PAY.  LOANS PAY. OTHER PAY. DEBENTURES "
50T$(166,220)="LT LOANS      NOTES      OTHER LT   STOCK $1PARR. EARNINGS"
60T$(221,275)="SERV. FEES ROYALTIES  ASSETS SOLDSOFTWARE   OTHER SALES"
70T$(276,330)="INVENTORY     ASSETS SOLDDEPRECIAT. OTHER      OTHER       "
80T$(331,385)="RENT          ELECTRIC   GAS        TELEPHONE  PUBLICATION"
90T$(386,440)="SUPPLIES      POSTAGE    TRANSPORT. SALARIES   OTHER       "
100 GOSUB1000\GOSUB1100
140 INPUT"MONTH : ",M\M=M-1
150 IFM<0ORM>11THEN140
160 !"INPUT: $AMOUNT, DEBIT ACC#, CREDIT ACC#, DEPT#, REF#"
170 !"0,0,0,0,0 ENDS INPUT"\A=0
180 !"ENTRY #",%4I,A+1,\INPUT" ? ",J(A,0),J(A,1),J(A,2),J(A,3),J(A,4)
182 IFJ(A,1)>39ORJ(A,1)<0THEN189
184 IFJ(A,2)>39ORJ(A,2)<0THEN189
186 IFJ(A,3)>2ORJ(A,3)<0THEN189\GOTO190
189 !"INVALID ENTRY REJECTED"\GOTO180
190 IFJ(A,0)=0THEN200\A=A+1\IFA<100THEN180
195 A=A-1
200 A=A-1
205 INPUT"SET PRINTER FOR LIST OF ENTRIES ? ",A$\!""
210 !"JOURNAL ENTRIES MONTH #",%3I,M+1
220 FORB=1TO27\!"=",\NEXT\!""\!""
230 !"ENTRY  $ AMOUNT   DEBIT          CREDIT         DEPT   REFERENCE"
240 FORB=1TO60\!"=",\NEXT\!""\!""
250 FORB=0TOA\T1=J(B,1)\GOSUB1200\T2=T1\T1=J(B,2)\GOSUB1200
260 !%5I,B+1,"  ",%$10F2,J(B,0)," ",T$(T2-10,T2)," ",
265 !T$(T1-10,T1),%6I,J(B,3),%12I,J(B,4)
270 NEXT\C=0
280 !"0 ENDS PROGRAM AND KILLS ALL ENTRIES"
290 !"1-100 CORRECTS AN ENTRY"
300 INPUT"OVER 100 ENTERS THE ENTRIES INTO THE FILE ? ",B\IFB=0THENEND
310 IFB>100THEN400\C=1\D=B-1\GOTO330
320 INPUT1"ENTRY NUMBER ?",D\D=D-1
330 IFD<0ORD>ATHEN320
340 INPUT"$,DEBIT,CRE,DEPT,REF ?",J(D,0),J(D,1),J(D,2),J(D,3),J(D,4)
350 IFJ(D,1)<0ORJ(D,1)>39THEN360
352 IFJ(D,2)<0ORJ(D,2)>39THEN360
354 IFJ(D,3)<0ORJ(D,3)>2THEN360\GOTO280
360 !"CORRECTION REJECTED"\GOTO340
400 IFC>0THEN205
410 FORB=0TOA\E=J(B,3)\FORC=1TO2\D=J(B,C)\IFC=2THENJ(B,0)=0-J(B,0)
420 IFD>19THEN430\B(D)=B(D)+J(B,0)\GOTO440
430 D=D-20\I(E,D,M)=I(E,D,M)+J(B,0)\B(19)=B(19)+J(B,0)
440 NEXT\NEXT\GOSUB1000\GOSUB1300\!""\!F$," UPDATED"\END
1000 INPUT"FILE : ",F$\OPEN#0,F$\RETURN
1100 FORA=0TO19\READ#0,B(A)\NEXT
1110 FORA=0TO2\FORB=0TO19\FORC=0TO11
1120 READ#0,I(A,B,C)\NEXT\NEXT\NEXT\CLOSE#0\RETURN
1200 T1=(T1+1)*11\RETURN
1300 FORA=0TO19\WRITE#0,B(A)\NEXT
1310 FORA=0TO2\FORB=0TO19\FORC=0TO11
1320 WRITE#0,I(A,B,C)\NEXT\NEXT\NEXT\CLOSE#0\RETURN
READY
```

Listing 3: ENTRY1, a program enabling the user to enter business transactions into the computer.

tains ten sectors or blocks, with 256 bytes of data on each sector. Every numerical variable written out to disks using the standard North Star Basic requires five bytes. Therefore, each data file is subdivided as follows:

Balance sheet items =	
20 X 5 bytes	= 100
Income items =	
20 X 3 subdepartments X	
12 months X 5 bytes	= 3600
	= 3700

The size of a data file is 15 blocks (3700 divided by 256). Listing 1 shows the first program of the system (LIST1). Listing 2 shows the output of LIST1. This program merely shows the codes (numerical between 0 and 39) used for each account and also allows us to erase all data from a given file name. A 15 block data file is created (using the North Star disk operating system commands: CR JJR76 15, TY JJR76 3) to keep track of the JJR Company for the year 1976. The company was formed in December of 1976 and has very limited transactions. These are entered into the accounting system via program ENTRY1 (shown in listing 3). Listing 4 details the entry of these transactions which is as follows:

1. Start business by purchasing 1000 shares of stock for $1000.
2. Buy $500 worth of machinery for cash.
3. Obtain a $250 piece of equipment for cash.
4. Purchase raw stock for $50.

ENTRY1, like the rest of the system's update programs, always asks for a data file at the beginning and a date file at the end of

```
FILE : JJR76
MONTH : 12
INPUT: $AMOUNT, DEBIT ACC#, CREDIT ACC#, DEPT#, REF#
0,0,0,0,0 ENDS INPUT
ENTRY #    1 ? 1000,0,18,0,1
ENTRY #    2 ? 500,6,0,0,2
ENTRY #    3 ? 200,7,0,0,3
ENTRY #    4 ? 50,8,0,0,4
ENTRY #    5 ? 0,0,00,0,0
SET PRINTER FOR LIST OF ENTRIES ?

JOURNAL ENTRIES MONTH #  12
===========================

ENTRY  $ AMOUNT   DEBIT          CREDIT          DEPT    REFERENCE
============================================================

    1   $1000.00 CASH           STOCK $1PAR       0            1
    2    $500.00 MACHINERY      CASH              0            2
    3    $200.00 EQUIPMENT      CASH              0            3
    4     $50.00 RAW STOCK      CASH              0            4
0 ENDS PROGRAM AND KILLS ALL ENTRIES
1-100 CORRECTS AN ENTRY
OVER 100 ENTERS THE ENTRIES INTO THE FILE ? 111
FILE : JJR76

JJR76 UPDATED
READY
```

Listing 4: A sample run of ENTRY1. The amounts and transaction codes (see listing 2) indicate that the company sold 1000 shares of stock for $1000, bought $500 worth of machinery for cash, obtained a $250 piece of equipment for cash, and purchased raw stock for $50.

```
10 DIMB(2,19),T$(440),Y(1),T(2,6),W(1,4),L(1,16),L$(77)
15 LINE80
16 L$(1,44)='  C. ASSETS  L. ASSETS  C. LIAB.   L. LIAB. '
18 L$(45,77)='  EQUITY   TOT. ASSETS TOT. LIA&EQ'
20T$(  1, 55)='CASH          SECURITIES RECEIVABLESINVENTORY  OTHER       '
30T$( 56,110)='PLANT         MACHINERY  EQUIPMENT  RAW STOCK  OTHER       '
40T$(111,165)='PAYABLES      TAXS PAY.  LOANS PAY. OTHER PAY. DEBENTURES '
50T$(166,220)='LT LOANS      NOTES      OTHER LT   STOCK $1PARR. EARNINGS'
60T$(221,275)='SERV. FEES ROYALTIES  ASSETS SOLDSOFTWARE    OTHER SALES'
70T$(276,330)='INVENTORY     ASSETS SOLDDEPRECIAT. OTHER      OTHER       '
80T$(331,385)='RENT          ELECTRIC   GAS        TELEPHONE  PUBLICATION'
90T$(386,440)='SUPPLIES      POSTAGE    TRANSPORT. SALARIES   OTHER       '
92 FORA=0TO4\READW(0,A),W(1,A)\NEXT
94 DATA0,4,5,9,10,13,14,17,18,19
96 INPUT'0 TO TRANSFER YEAR TO YEAR ?',A
98 IFA=0THENGOSUB4000
100 FORD=0TO1\GOSUB1000\GOSUB1100\INPUT'WHAT YEAR WAS THAT ? ',Y(D)
110 NEXT
120 INPUT'DATE ? ',D$\INPUT'GET PRINTER READY ? ',A$
130 !'BALANCE SHEET AS OF ',D$
132 !%21I,Y(0),%9I,Y(1),'    DIFF = ',
134 !%21I,Y(0),%9I,Y(1),'    DIFF'
136 FORA=1TO8\!'==========',\NEXT\!''
140 FORA=0TO19\B(2,A)=B(0,A)-B(1,A)\IFA>16THEN145\READL(0,A),L(1,A)
145 NEXT
150 FORA=0TO4\C=W(0,A)\D=W(1,A)\FORB=0TO2
160 FORE=CTOD\T(B,A)=T(B,A)+B(B,E)
170 NEXTE\NEXTB\NEXTA
180 FORA=0TO2\T(A,5)=T(A,0)+T(A,1)
190 T(A,6)=T(A,2)+T(A,3)+T(A,4)\NEXT
200 FORA=0TO16\FORB=0TO1
210 IF200>L(B,A)THEN230
220 !'                                          ',\GOTO400
230 IF100>L(B,A)THEN260
240 T3=L(B,A)-100\T1=T3\GOSUB1200
250 !L$(T1-10,T1),' ',%9F2,T(0,T3),T(1,T3),%8F2,T(2,T3),\GOTO400
260 T3=L(B,A)\T1=T3\GOSUB1200
270 !T$(T1-10,T1),' ',%9F2,B(0,T3),B(1,T3),%8F2,B(2,T3),
400 IFB=1THEN410\!' = ',\GOTO420
410 !''
420 NEXT\NEXT\!''\END
1000 INPUT'FILE : ',F$\OPEN#0,F$\RETURN
1100 FORA=0TO19\READ#0,B(D,A)\NEXT\CLOSE#0\RETURN
1200 T1=(T1+1)*11\RETURN
2000 DATA0,10,1,11,2,12,3,13,4,102,100,200,200,14,200,15,200,16
2002 DATA5,17,6,103,7,200,8,18,9,19,101,104,200,200,105,106
4000 INPUT'GIVE FILE TO BE TRANSFERED ? ',F$
4010 OPEN#0,F$\FORA=0TO19\READ#0,B(0,A)\NEXT\CLOSE#0
4020 INPUT'GIVE FILE TO RECEIVE DATA ? ',F$
4030 OPEN#0,F$\FORA=0TO19\WRITE#0,B(0,A),NOENDMARK\NEXT
4035 CLOSE#0\RETURN
READY
```

Listing 5: BAL1, a program that calculates a year end balance sheet. The program is capable of transferring the previous year's records to the current year.

the program. This makes it possbile to save the original file and to produce a new file, which is the original plus any updates. In the example, only one file (JJR76) is used.

Since the transactions shown were the only transactions for the year, it is now possible to run a year end balance sheet. Program BAL1 (listing 5) is executed. Listing 6 shows a sample run of the program. BAL1 first asks if any of the balance sheet items are to be transferred to a new file. This is important because all of 1976's year-end assets, liabilities and equity balances must be transferred to the new year, 1977. Therefore, the user should instruct the program to transfer 1976 balance sheet items (file JJR76) to 1977 (file JJR77).

The balance sheet program also allows for comparisons to be made and asks for two files to be compared. Since this is JJR's first year of operation, we are forced to compare 1976 to 1976. The balance sheet is now produced.

Note that the balance sheet is printed by lines 200 to 420 of the program. A programming trick has been used to shorten the length of the actual program. As the example shows, the balance sheet is composed of 17 lines with two entries per line, or 34 total entries. There are 20 individual items, seven totals and seven blank items. Array L(1,16) determines which items appear on each line. An L(1,16) value of 0 to 19 refers to a particular account, 100 to 106 is linked to a total, and 200 is used to generate blanks. Lines 2000 and 2002 show the values of L(1,16). I point this out because most of the financial statements were produced using this method.

During 1977 our small business has expanded by hiring a local salesperson. However, sales do not take place until November, and our proprietor wants to segregate the revenue generated by himself from the sales brought in by the sales-

```
0 TO TRANSFER YEAR TO YEAR ?0
GIVE FILE TO BE TRANSFERED ? JJR76
GIVE FILE TO RECEIVE DATA ? JJR77
FILE : JJR76
WHAT YEAR WAS THAT ? 1976
FILE : JJR76
WHAT YEAR WAS THAT ? 1976
DATE ? 12/31/76
GET PRINTER READY ?

BALANCE SHEET AS OF 12/31/76
                     1976      1976     DIFF =                     1976      1976     DIFF
================================================================================
CASH              250.00    250.00      .00 = PAYABLES             .00       .00      .00
SECURITIES           .00       .00      .00 = TAXS PAY.            .00       .00      .00
RECEIVABLES          .00       .00      .00 = LOANS PAY.           .00       .00      .00
INVENTORY            .00       .00      .00 = OTHER PAY.           .00       .00      .00
OTHER                .00       .00      .00 =   C. LIAB.           .00       .00      .00
  C. ASSETS       250.00    250.00      .00 =
                                            = DEBENTURES           .00       .00      .00
                                            = LT LOANS             .00       .00      .00
                                            = NOTES                .00       .00      .00
PLANT                .00       .00      .00 = OTHER LT             .00       .00      .00
MACHINERY         500.00    500.00      .00 =   L. LIAB.           .00       .00      .00
EQUIPMENT         200.00    200.00      .00 =
RAW STOCK          50.00     50.00      .00 = STOCK $1PAR     -1000.00  -1000.00      .00
OTHER                .00       .00      .00 = R. EARNINGS          .00       .00      .00
  L. ASSETS       750.00    750.00      .00 =   EQUITY        -1000.00  -1000.00      .00
                                            =
TOT. ASSETS      1000.00   1000.00      .00 =  TOT. LIA&E     -1000.00  -1000.00      .00

READY
```

Listing 6: A sample run of BAL1.

```
10 DIMB(2,19,11)
100 !'USE BUDGET FILES ONLY ? ',\GOSUB1000\GOSUB1100
110 !' 0 TO ADD TO EXISTING BUDGETS'
120 !'1 TO OVER RIDE EXISTING BUDGETS'
130 INPUT'2 TO END ? ',A\IFA<2THEN140\GOSUB1000\GOSUB1300\END
140 INPUT'DEPT,FIRST MONTH, END MONTH ? ',B,C,D
142 IFB<0ORB>2THEN300
144 IFD<CTHEN300
146 IFD<1ORD>12THEN300
148 IFC<1ORC>12THEN300
150 INPUT'ACCOUNT, AMOUNT ($.01 RETURNS TO START) ? ',E,F
155 E=E-20
160 IFF=.01THEN110\IFE<0ORE>19THEN300
170 FORG=CTOD\IFA=0THEN190
180 B(B,E,G-1)=F\GOTO200
190 B(B,E,G-1)=F+B(B,E,G-1)
200 NEXT\GOTO150
300 !'LAST ENTRY INCORRECT'\GOTO110
1000 INPUT'FILE : ',F$\OPEN#0,F$\RETURN
1100 FORA=0TO19\READ#0,B\NEXT
1110 FORA=0TO2\FORB=0TO19\FORC=0TO11
1120 READ#0,B(A,B,C)\NEXT\NEXT\NEXT\CLOSE#0\RETURN
1300 FORA=0TO19\WRITE#0,Z9\NEXT
1310 FORA=0TO2\FORB=0TO19\FORC=0TO11
1320 WRITE#0,B(A,B,C)\NEXT\NEXT\NEXT\CLOSE#0\RETURN
READY
```

Listing 7: BUD-IN1, a program that generates budgets and enables the user to keep separate records of, for instance, the sales generated by each salesperson in the organization.

```
FILE : JJR77
MONTH : 11
INPUT: $AMOUNT, DEBIT ACC#, CREDIT ACC#, DEPT#, REF#
0,0,0,0,0 ENDS INPUT
ENTRY #    1 ? 500,2,21,0,5
ENTRY #    2 ? 0,0,0,0,0
SET PRINTER FOR LIST OF ENTRIES ?

JOURNAL ENTRIES MONTH # 11
===========================

ENTRY  $ AMOUNT   DEBIT        CREDIT        DEPT   REFERENCE
===============================================================

    1      $500.00 RECEIVABLES ROYALTIES       0            5
0 ENDS PROGRAM AND KILLS ALL ENTRIES
1-100 CORRECTS AN ENTRY
OVER 100 ENTERS THE ENTRIES INTO THE FILE ? 111
FILE : JJR77

JJR77 UPDATED
READY
RUN

FILE : JJR77
MONTH : 12
INPUT: $AMOUNT, DEBIT ACC#, CREDIT ACC#, DEPT#, REF#
0,0,0,0,0 ENDS INPUT
ENTRY #    1 ? 100,27,6,0,6
ENTRY #    2 ? 150,30,10,0,7
ENTRY #    3 ? 200,1,23,1,8
ENTRY #    4 ? 50,25,8,1,9
ENTRY #    5 ? 100,38,200,1,10
INVALID ENTRY REJECTED
ENTRY #    5 ? 100,38,1,1,10
ENTRY #    6 ? 0,0,0,0,0
SET PRINTER FOR LIST OF ENTRIES ?

JOURNAL ENTRIES MONTH # 12
===========================

ENTRY  $ AMOUNT   DEBIT        CREDIT        DEPT   REFERENCE
===============================================================

    1      $100.00 DEPRECIAT.  MACHINERY       0            6
    2      $150.00 RENT        PAYABLES        0            7
    3      $200.00 SECURITIES  SOFTWARE        1            8
    4       $50.00 INVENTORY   RAW STOCK       1            9
    5      $100.00 SALARIES    SECURITIES      1           10
0 ENDS PROGRAM AND KILLS ALL ENTRIES
1-100 CORRECTS AN ENTRY
OVER 100 ENTERS THE ENTRIES INTO THE FILE ? 111
FILE : JJR77

JJR77 UPDATED
READY
```

Listing 9: Updated accounting sheet of the company's activities for November and December 1977, generated by ENTRY1.

```
LOAD BUD-IN1
READY
RUN

USE BUDGET FILES ONLY ? FILE : BUD
 0 TO ADD TO EXISTING BUDGETS
1 TO OVER RIDE EXISTING BUDGETS
2 TO END ? 1
DEPT,FIRST MONTH, END MONTH ? 1,11,12
ACCOUNT, AMOUNT ($.01 RETURNS TO START) ? 23,-90
ACCOUNT, AMOUNT ($.01 RETURNS TO START) ? 25,15
ACCOUNT, AMOUNT ($.01 RETURNS TO START) ? 38,40
ACCOUNT, AMOUNT ($.01 RETURNS TO START) ? 0,.01
 0 TO ADD TO EXISTING BUDGETS
1 TO OVER RIDE EXISTING BUDGETS
2 TO END ? 2
FILE : BUD
READY
```

Listing 8: A sample run of BUD-IN1.

person. Therefore, the salesperson's activities are placed in department 1: local sales. Listing 7 shows the budget input program BUD-IN1 (see also listing 8).

The budgets are coded like the journal entries and the file containing budget information is identical to the other actual data files, JJR76 and JJR77. For ease of entry, there are two options for entering budget data. One option allows us to add incremental amounts to existing budgets; the other allows for the entry of brand new absolute budget amounts. The amounts entered can be for one or more months. In our sample, the local sales department will be assigned specific budgets for:

1. $90 of software sales in November and December.
2. Inventory usage of $15 for both months.
3. November and December salary costs of $40.

These figures are entered into file BUD. The system, by asking for both read and write files, allows you to save as many versions of a budget as you desire. That ends the 1976 transaction.

No activity took place in our small business between January 1977 and October 1977. However, in November the following item is entered via the ENTRY1 program:

1. The proprietor receives $500 in cash for royalties.

This, as well as December's activity, is shown in listing 9. During December, the following journal entries are made for administration, department 0:

1. Depreciation of $100 is booked.
2. A rent liability of $150 is incurred.

The salesman's department 1 has the following activity:

3. $200 in software is sold for securities.
4. The software was written on $50 worth of raw stock.

```
0 TO TRANSFER YEAR TO YEAR ?1
FILE : JJR77
WHAT YEAR WAS THAT ? 1977
FILE : JJR76
WHAT YEAR WAS THAT ? 1976
DATE ? 12/31/77
GET PRINTER READY ?

BALANCE SHEET AS OF 12/31/77
                  1977      1976      DIFF =                    1977      1976      DIFF
==========================================================================================
CASH            250.00    250.00       .00 = PAYABLES        -150.00       .00   -150.00
SECURITIES      100.00       .00    100.00 = TAXS PAY.           .00       .00       .00
RECEIVABLES     500.00       .00    500.00 = LOANS PAY.          .00       .00       .00
INVENTORY          .00       .00       .00 = OTHER PAY.          .00       .00       .00
OTHER              .00       .00       .00 =   C. LIAB.      -150.00       .00   -150.00
  C. ASSETS     850.00    250.00    600.00 =
                                           = DEBENTURES          .00       .00       .00
                                           = LT LOANS            .00       .00       .00
                                           = NOTES               .00       .00       .00
PLANT              .00       .00       .00 = OTHER LT            .00       .00       .00
MACHINERY       400.00    500.00   -100.00 =   L. LIAB.          .00       .00       .00
EQUIPMENT       200.00    200.00       .00 =
RAW STOCK          .00     50.00    -50.00 = STOCK $1PAR    -1000.00  -1000.00       .00
OTHER              .00       .00       .00 = R. EARNINGS     -300.00       .00   -300.00
  L. ASSETS     600.00    750.00   -150.00 =   EQUITY       -1300.00  -1000.00   -300.00
                                           =
TOT. ASSETS    1450.00   1000.00    450.00 =  TOT. LIA&E    -1450.00  -1000.00   -450.00

READY
```

Listing 10: Year end balance sheet for the JJR company and a comparison with the previous year.

```
10 DIMB(19),I(3,19,12),T$(440),D$(33),T(3,3,12),W(1,2),O$(44)
12 D$(1,33)='ADMINIST.  LOCAL SALESNAT. SALES '
15 LINE132
20T$(  1, 55)='CASH      SECURITIES RECEIVABLESINVENTORY  OTHER      '
30T$( 56,110)='PLANT     MACHINERY  EQUIPMENT  RAW STOCK  OTHER      '
40T$(111,165)='PAYABLES  TAXS PAY.  LOANS PAY. OTHER PAY. DEBENTURES '
50T$(166,220)='LT LOANS  NOTES      OTHER LT   STOCK $1PARR. EARNINGS'
60T$(221,275)='SERV. FEES ROYALTIES ASSETS SOLDSOFTWARE   OTHER SALES'
70T$(276,330)='INVENTORY  ASSETS SOLDDEPRECIAT. OTHER     OTHER      '
80T$(331,385)='RENT      ELECTRIC   GAS        TELEPHONE  PUBLICATION'
90T$(386,440)='SUPPLIES  POSTAGE    TRANSPORT. SALARIES   OTHER      '
100 GOSUB1000\GOSUB1100
120 FORA=0TO2\READW(0,A),W(1,A)\NEXT
124 DATA0,4,5,9,10,19
126 O$(1,44)='TOTAL SALESCOST OF GS OTHER EXP. -PROF./LOSS'
130 FORA=0TO3
132 !'INCOME STATEMENT       '\IFA=3THEN138
134 T1=A\GOSUB1200\!D$(T1-10,T1),' DEPARTMENT'\GOTO140
138 !'TOTAL OF ALL DEPARTMENTS'
140 !'ITEM           ',\FORF=1TO12\!'  MON-',%2I,F,\NEXT
150 !'     TOTAL'\GOSUB1500
170 FORB=0TO2\C=W(0,B)\D=W(1,B)\FORE=CTOD
180 T1=E+20\GOSUB1200\!T$(T1-10,T1),' ',
190 FORF=0TO11\!%8F2,I(A,E,F),\I(A,E,12)=I(A,E,12)+I(A,E,F)
195 IFA=3THEN205
200 I(3,E,F)=I(3,E,F)+I(A,E,F)
205 T(A,B,F)=T(A,B,F)+I(A,E,F)
210 NEXTF\!%9F2,I(A,E,12)\NEXTE\T1=B\GOSUB1200\GOSUB1500
215 !O$(T1-10,T1),' ',
220 FORF=0TO11\!%8F2,T(A,B,F),\T(A,B,12)=T(A,B,12)+T(A,B,F)\NEXTF
230 !%9F2,T(A,B,12)\!''
235 FORF=0TO12\T(A,3,F)=T(A,3,F)+T(A,B,F)\NEXT
238 NEXTB\!''
240 !O$(34,44),' ',\FORF=0TO11
245 !%8F2,T(A,3,F),\NEXT\!%9F2,T(A,3,12)
247 FORF=1TO33\!' '\NEXT
250 NEXTA\END
1000 INPUT'FILE : ',F$\OPEN#0,F$\RETURN
1100 FORA=0TO19\READ#0,B(A)\NEXT
1110 FORA=0TO2\FORB=0TO19\FORC=0TO11
1120 READ#0,I(A,B,C)\NEXT\NEXT\NEXT\CLOSE#0\RETURN
1200 T1=(T1+1)*11\RETURN
1500 FORZ=1TO117\!'=',\NEXT\!''\RETURN
READY
```

Listing 11: INCOME1, a program designed to show assets and liabilities for any or all company departments over a 1 year period.

5. An invalid account number 200 is disallowed by the program.
6. $100 of securities is paid to the salesperson as salary.

Listing 9 shows an update of the company's activities for 1977. In listing 10 the year end 1977 balance sheet is run and compared to year end 1976. Program INCOME1 (listing 11) is loaded and run. Listing 12a shows the administration account, listing 12b the local sales department, listing 12c is the consolidation of the three accounts (national sales, unused account in these examples, was not shown). This program requires as input only the data file's name.

Listings 14a and 14b show the budget program (BUD1) in action (see also listing 13). Since the file structure remains the same throughout, you can compare any quantities you like, and since all 12 months are stored on disk, any month can be printed. Like the 12 month income statement, all three departments and a summary can be produced.

The inputs for this program are:

1. MONTH: the particular month of the report.
2. ACT File: file name for the current data.
3. BUD File: file name for a budget or prior year's results that you want to compare to the current year's.
4. L.Y. File: last year's file name or any other file.
5. 0,0 for department 0.
   1,1 for department 1.
   2,2 for department 2.
   0,1 for departments 0 and 1.
   1,2 for departments 1 and 2.
   0,2 for departments 0, 1 and 2.
   0,3 for all departments and a summary.

About the Author

Joseph J Roehrig is currently manager of budgets, operations and engineering for the NBC Television Network. He was previously in charge of television network systems at NBC, during which time he worked with hardware configurations. Mr Roehrig is also president of JJR Data Research, a computer software service.

FILE : JJR77
INCOME STATEMENT
ADMINIST. DEPARTMENT

ITEM	MON- 1	MON- 2	MON- 3	MON- 4	MON- 5	MON- 6	MON- 7	MON- 8	MON- 9	MON-10	MON-11	MON-12	TOTAL
SERV. FEES	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ROYALTIES	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-500.00	.00	-500.00
ASSETS SOLD	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
SOFTWARE	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
OTHER SALES	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL SALES	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-500.00	.00	-500.00
INVENTORY	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ASSETS SOLD	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
DEPRECIAT.	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	100.00	100.00
OTHER	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
OTHER	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
COST OF GS	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	100.00	100.00
RENT	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	150.00	150.00
ELECTRIC	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
GAS	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
TELEPHONE	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
PUBLICATION	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
SUPPLIES	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
POSTAGE	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
TRANSPORT.	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
SALARIES	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
OTHER	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
OTHER EXP.	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	150.00	150.00
-PROF./LOSS	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-500.00	250.00	-250.00

Listing 12a: An example of a typical INCOME run, showing the yearly record for the administrative department of the JJR company for 1977.

INCOME STATEMENT
LOCAL SALES DEPARTMENT

ITEM	MON- 1	MON- 2	MON- 3	MON- 4	MON- 5	MON- 6	MON- 7	MON- 8	MON- 9	MON-10	MON-11	MON-12	TOTAL
SERV. FEES	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ROYALTIES	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ASSETS SOLD	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
SOFTWARE	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-200.00	-200.00
OTHER SALES	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL SALES	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-200.00	-200.00
INVENTORY	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	50.00	50.00
ASSETS SOLD	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
DEPRECIAT.	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
OTHER	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
OTHER	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
COST OF GS	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	50.00	50.00
RENT	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ELECTRIC	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
GAS	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
TELEPHONE	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
PUBLICATION	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
SUPPLIES	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
POSTAGE	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
TRANSPORT.	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
SALARIES	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	100.00	100.00
OTHER	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
OTHER EXP.	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	100.00	100.00
-PROF./LOSS	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-50.00	-50.00

Listing 12b: An INCOME run for the JJR company's local sales department for 1977.

INCOME STATEMENT
TOTAL OF ALL DEPARTMENTS

ITEM	MON- 1	MON- 2	MON- 3	MON- 4	MON- 5	MON- 6	MON- 7	MON- 8	MON- 9	MON-10	MON-11	MON-12	TOTAL
SERV. FEES	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
ROYALTIES	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-500.00	.00	-500.00
ASSETS SOLD	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
SOFTWARE	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-200.00	-200.00
OTHER SALES	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
TOTAL SALES	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-500.00	-200.00	-700.00
INVENTORY	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	50.00	50.00
ASSETS SOLD	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
DEPRECIAT.	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	100.00	100.00
OTHER	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
OTHER	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
COST OF GS	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	150.00	150.00
RENT	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	150.00	150.00
ELECTRIC	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
GAS	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
TELEPHONE	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
PUBLICATION	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
SUPPLIES	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
POSTAGE	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
TRANSPORT.	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
SALARIES	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	100.00	100.00
OTHER	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
OTHER EXP.	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	250.00	250.00
-PROF./LOSS	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	-500.00	200.00	-300.00

Listing 12c: An INCOME run for all departments for the JJR company in 1977.

```
10 DIMR(2,19,12),T$(220),D$(33),T(3,3,8),W(1,2),O$(44),I(3,19,7)
12 D$(1,33)='ADMINIST.  LOCAL SALESNAT. SALES '
15 LINE80
17 Z$='ACTBUDL-Y'
60T$(  1, 55)='SERV. FEES ROYALTIES  ASSETS SOLDSOFTWARE   OTHER SALES'
70T$( 56,110)='INVENTORY  ASSETS SOLDDEPRECIAT. OTHER      OTHER      '
80T$(111,165)='RENT       ELECTRIC   GAS        TELEPHONE  PUBLICATION'
90T$(166,220)='SUPPLIES   POSTAGE    TRANSPORT. SALARIES   OTHER      '
92 INPUT'MONTH ?',M\M=M-1
94 FORA1=1TO3\B=A1*3\!Z$(B-2,B),'    ',
95 GOSUB1000\GOSUB1100\A=A1
96 E=A+4\FORB=0TO2\FORC=0TO19\FORD=0TOM
98 I(B,C,E)=I(B,C,E)+R(B,C,D)
100 IFM=DTHENI(B,C,A)=R(B,C,D)
102 NEXTD\NEXTC\NEXTB\NEXTA1
106 FORA=0TO4STEP4\FORB=0TO2\FORC=0TO19
108 I(B,C,A)=I(B,C,A+2)-I(B,C,A+1)
110 NEXTC\NEXTB\NEXTA
115 INPUT'A DEPARTMENT #, SAME # OR 0,3 ? ',A1,A2
120 FORA=0TO2\READW(0,A),W(1,A)\NEXT
124 DATA0,4,5,9,10,19
126 O$(1,44)='TOTAL SALESCOST OF GS OTHER EXP. -PROF./LOSS'
130 FORA=A1TOA2
132 !'BUDGET STATEMENT'\IFA=3THEN138
134 T1=A\GOSUB1200\!D$(T1-10,T1),' DEPARTMENT'\GOTO140
138 !'TOTAL OF ALL DEPARTMENTS'
140 !TAB(26),'MONTH #',%3I,M+1,
141 !TAB(55),'YEAR TO DATE'
142 !'                   ===========================      ',
143 !                   '==========================='
144 !'ITEMS                VAR.     ACT.     BUD     L.Y.     VAR.',
146 !'     ACT.     BUD.     L.Y.'\GOSUB1500
170 FORB=0TO2\C=W(0,B)\D=W(1,B)\FORE=CTOD
180 T1=E   \GOSUB1200\!T$(T1-10,T1),' ',
190 FORF=0TO7\!%8F2,I(A,E,F),
195 IFA=3THEN205
200 I(3,E,F)=I(3,E,F)+I(A,E,F)
205 T(A,B,F)=T(A,B,F)+I(A,E,F)
210 NEXTF\!''\NEXTE\T1=B\GOSUB1200\GOSUB1500
215 !O$(T1-10,T1),' ',
220 FORF=0TO7\!%8F2,T(A,B,F),\NEXTF\!''
230 !''\FORF=0TO7\T(A,3,F)=T(A,3,F)+T(A,B,F)\NEXT
238 NEXTB\!''
240 !O$(34,44),' ',\FORF=0TO7
245 !%8F2,T(A,3,F),\NEXT\!''
247 FORF=1TO33\!' '\NEXT
250 NEXTA\END
1000 INPUT'FILE : ',F$\OPEN#0,F$\RETURN
1100 FORA=0TO19\READ#0,B\NEXT
1110 FORA=0TO2\FORB=0TO19\FORC=0TO11
1120 READ#0,R(A,B,C)\NEXT\NEXT\NEXT\CLOSE#0\RETURN
1200 T1=(T1+1)*11\RETURN
1500 FORZ=1TO80 \!'=',\NEXT\!''\RETURN
READY
```

Listing 13: BUD1, a program designed to give a more detailed picture of individual departments' performance than is found in the INCOME program (see listing 11).

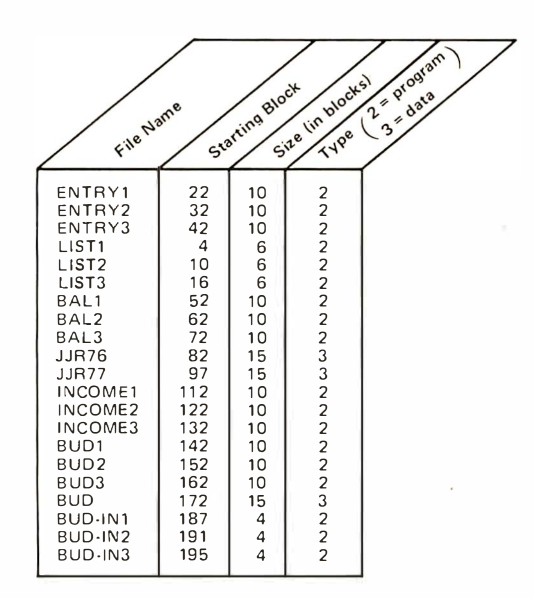
```
MONTH ?11
ACT   FILE : JJR77
BUD   FILE : BUD
L-Y   FILE : JJR76
A DEPARTMENT #, SAME # OR 0,3 ? 1,1
BUDGET STATEMENT
LOCAL SALES DEPARTMENT
                          MONTH # 11                        YEAR TO DATE
                 ============================       ==========================
ITEMS             VAR.     ACT.     BUD     L.Y.     VAR.     ACT.     BUD.     L.Y.
==================================================================================
SERV. FEES         .00      .00      .00     .00      .00      .00      .00      .00
ROYALTIES          .00      .00      .00     .00      .00      .00      .00      .00
ASSETS SOLD        .00      .00      .00     .00      .00      .00      .00      .00
SOFTWARE        -90.00      .00   -90.00     .00   -90.00      .00   -90.00      .00
OTHER SALES        .00      .00      .00     .00      .00      .00      .00      .00
==================================================================================
TOTAL SALES     -90.00      .00   -90.00     .00   -90.00      .00   -90.00      .00

INVENTORY        15.00      .00    15.00     .00    15.00      .00    15.00      .00
ASSETS SOLD        .00      .00      .00     .00      .00      .00      .00      .00
DEPRECIAT.         .00      .00      .00     .00      .00      .00      .00      .00
OTHER              .00      .00      .00     .00      .00      .00      .00      .00
OTHER              .00      .00      .00     .00      .00      .00      .00      .00
==================================================================================
COST OF GS       15.00      .00    15.00     .00    15.00      .00    15.00      .00

RENT               .00      .00      .00     .00      .00      .00      .00      .00
ELECTRIC           .00      .00      .00     .00      .00      .00      .00      .00
GAS                .00      .00      .00     .00      .00      .00      .00      .00
TELEPHONE          .00      .00      .00     .00      .00      .00      .00      .00
PUBLICATION        .00      .00      .00     .00      .00      .00      .00      .00
SUPPLIES           .00      .00      .00     .00      .00      .00      .00      .00
POSTAGE            .00      .00      .00     .00      .00      .00      .00      .00
TRANSPORT.         .00      .00      .00     .00      .00      .00      .00      .00
SALARIES         40.00      .00    40.00     .00    40.00      .00    40.00      .00
OTHER              .00      .00      .00     .00      .00      .00      .00      .00
==================================================================================
OTHER EXP.       40.00      .00    40.00     .00    40.00      .00    40.00      .00

-PROF./LOSS     -35.00      .00   -35.00     .00   -35.00      .00   -35.00      .00
```

Listing 14a: A sample run of BUD1, showing a breakdown of activities for November 1977. ACT stands for actual, BUD for budgeted amounts, L.Y. for last year, and VAR for variance. VAR indicates the difference between the budgeted amount and the actual amount taken in or paid out. L.Y. indicates the amounts for the previous November and is included for reference only.



File Name	Starting Block	Size (in blocks)	Type (2 = program, 3 = data)
ENTRY1	22	10	2
ENTRY2	32	10	2
ENTRY3	42	10	2
LIST1	4	6	2
LIST2	10	6	2
LIST3	16	6	2
BAL1	52	10	2
BAL2	62	10	2
BAL3	72	10	2
JJR76	82	15	3
JJR77	97	15	3
INCOME1	112	10	2
INCOME2	122	10	2
INCOME3	132	10	2
BUD1	142	10	2
BUD2	152	10	2
BUD3	162	10	2
BUD	172	15	3
BUD-IN1	187	4	2
BUD-IN2	191	4	2
BUD-IN3	195	4	2

Table 1: Table of contents for the floppy disk showing the locations of all programs used in this accounting system.

Listing 14a shows the November results for local sales, and listing 14b shows the December results. A listing of the table of contents for the disk containing all of the accounting information is shown in listing 15. The data shown consists of file name, starting block, size in blocks and type (2 = program and 3 = data).

The file structure described earlier is fairly simple. Therefore, it is easy to add more programs to the system. The programs can calculate salaries, depreciation and accounts receivable, and enter this information directly into the data files. The account titles used in the programs are generally found in lines 20 to 90 and can be modified for other usages. The number of accounts can be easily expanded within the current 24 K programmable memory space by limiting the income statement subdivisions or by eliminating the monthly history. Quarterly type reports can also be added.

If you plan to enter these programs into your system, start with program LIST1. Most of the other programs can be formed by editing this particular program.■

```
MONTH ?12
ACT   FILE : JJR77
BUD   FILE : BUD
L-Y   FILE : JJR76
A DEPARTMENT #, SAME # OR 0,3 ? 1,1

BUDGET STATEMENT
LOCAL SALES DEPARTMENT
                          MONTH # 12                        YEAR TO DATE
                 ============================       ==========================
ITEMS             VAR.     ACT.     BUD     L.Y.     VAR.     ACT.     BUD.     L.Y.
==================================================================================
SERV. FEES         .00      .00      .00     .00      .00      .00      .00      .00
ROYALTIES          .00      .00      .00     .00      .00      .00      .00      .00
ASSETS SOLD        .00      .00      .00     .00      .00      .00      .00      .00
SOFTWARE        110.00  -200.00   -90.00     .00    20.00  -200.00  -180.00      .00
OTHER SALES        .00      .00      .00     .00      .00      .00      .00      .00
==================================================================================
TOTAL SALES     110.00  -200.00   -90.00     .00    20.00  -200.00  -180.00      .00

INVENTORY       -35.00    50.00    15.00     .00   -20.00    50.00    30.00      .00
ASSETS SOLD        .00      .00      .00     .00      .00      .00      .00      .00
DEPRECIAT.         .00      .00      .00     .00      .00      .00      .00      .00
OTHER              .00      .00      .00     .00      .00      .00      .00      .00
OTHER              .00      .00      .00     .00      .00      .00      .00      .00
==================================================================================
COST OF GS      -35.00    50.00    15.00     .00   -20.00    50.00    30.00      .00

RENT               .00      .00      .00     .00      .00      .00      .00      .00
ELECTRIC           .00      .00      .00     .00      .00      .00      .00      .00
GAS                .00      .00      .00     .00      .00      .00      .00      .00
TELEPHONE          .00      .00      .00     .00      .00      .00      .00      .00
PUBLICATION        .00      .00      .00     .00      .00      .00      .00      .00
SUPPLIES           .00      .00      .00     .00      .00      .00      .00      .00
POSTAGE            .00      .00      .00     .00      .00      .00      .00      .00
TRANSPORT.         .00      .00      .00     .00      .00      .00      .00      .00
SALARIES        -60.00   100.00    40.00     .00   -20.00   100.00    80.00      .00
OTHER              .00      .00      .00     .00      .00      .00      .00      .00
==================================================================================
OTHER EXP.      -60.00   100.00    40.00     .00   -20.00   100.00    80.00      .00

-PROF./LOSS      15.00   -50.00   -35.00     .00   -20.00   -50.00   -70.00      .00
```

Listing 14b: A similar breakdown for December 1977.

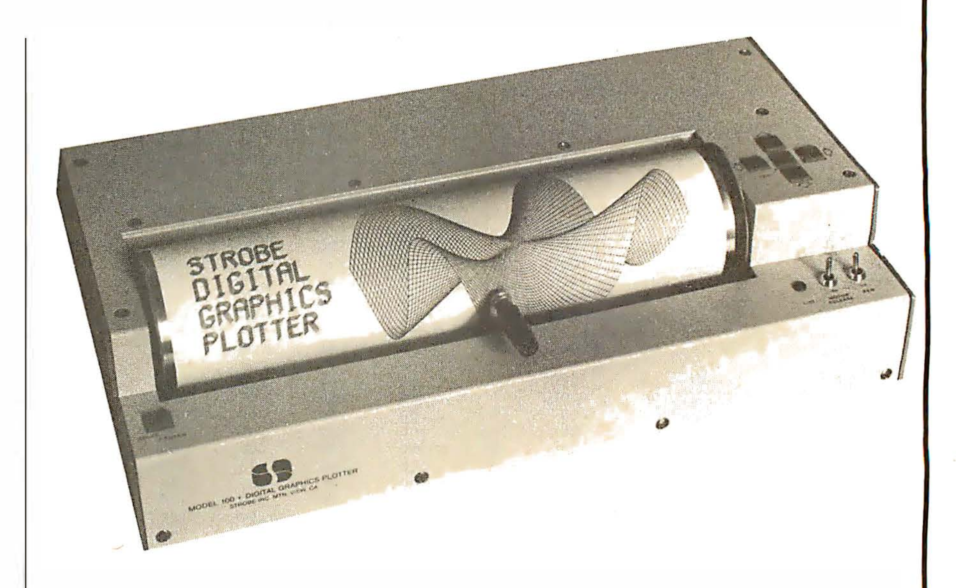
What's New?

PERIPHERALS

Disk Controller from Shugart

A microprocessor-based disk controller with on-board data separator logic capable of controlling up to four Winchester hard- or floppy-disk drives is available from Shugart, 435 Oakmead Pky, Sunnyvale CA 94086, (408) 733-0100. The SA1400 features automatic copying of disks, sector interleaving, error correction code autonomous to the microprocessor, and optional microdiagnostics. Data transfer between the controller and the host microprocessor is improved by sector buffering. The SA1400 is based on a bit-slice microprocessor and works with Shugart SA1000 8-inch and SA4000 14-inch Winchester drives and SA800/850 8-inch floppy-disk drives. Other functions include overlapped seek operations, integral data separators, automatic switching of head and cylinder, and optional track formats. Write precompensation is also included on the board. The Shugart standard floppy-disk protocol and either of the SA1000 or SA4000 fixed-disk protocols are used for the interface to the drive. A general-purpose interface is used to transfer commands and data between the host processor and the controller. In original equipment manufacturer's quantities, the SA1400 is $1125.

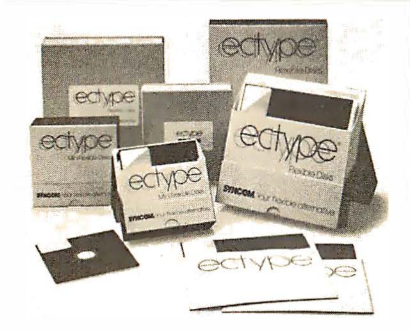
Circle 539 on inquiry card.



Drum-Type Graphics Plotter

Strobe Inc has introduced a drum-type graphics plotter with a 0.004-inch step size, and a 21.6 by 28 cm (8.5 by 11 in) paper capacity. The interactve digitizing mode allows the user to enter directly into the host computer X,Y coordinate data corresponding to pen location. The Model 100 plotter is controlled by the computer through two parallel output ports and one parallel input port. Hardware interfaces and software drivers are available for the Apple II, TRS-80, PET, and S-100 machines. An optional plot software package, providing vector generation and alphanumerics, that runs with most versions of BASIC and FORTRAN is also available. The price of the Model 100 plotter is $680. For details, contact Strobe Inc, 897-5A Independence Ave, Mountain View CA 94043, (415) 969-5130.

Circle 540 on inquiry card.



Ectype Floppy Disks from Syncom

The Ectype 8- and 5-inch floppy disks have a wear life exceeding 10 million passes for both hard- and soft-sector operations. The disks are 100% certified, and are made for IBM and non-IBM equipment with other formats available. Syncom also manufactures Ectype MC/ST magnetic cards and Ectype 3348-70 Data Modules. For more information, contact Bozell & Jacobs Public Relations, Butler Sq, 100 N 6th St, Minneapolis MN 55403, (612) 371-5500.

Circle 541 on inquiry card.

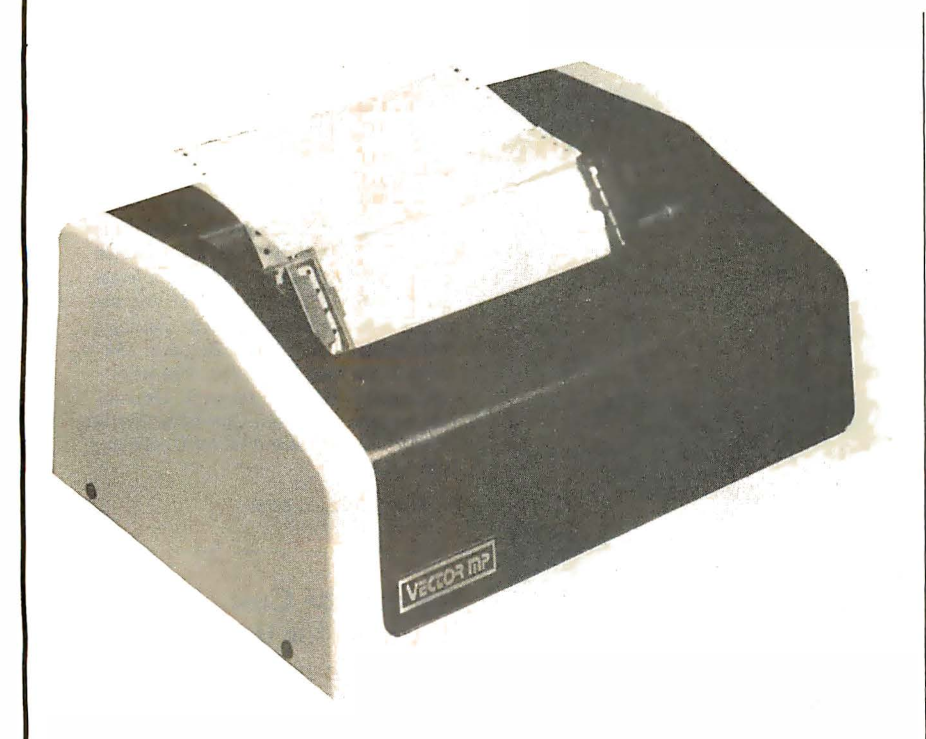
DC 100A Tape Cartridge Drive

The Moya Corporation, located at 6311 DeSoto Ave, Unit H, Woodland Hills CA 91367, (213) 533-5993, has introduced the MicroDrive/OEM series of tape drives which offer up to 1.344 megabytes of storage in a package that measures 467 cubic cm (28.5 cubic inches). The transport is available with the mechanism-only board or the minimum-electronics board. Both models include a maximum data capacity of 1.344 megabytes, a transfer rate of 48 K bytes per second, read/write speed of 30 ips (inches per second), and search/rewind speed of 90 ips. The mechanism-only board contains the circuitry required to interface the transport mechanism. The minimum-electronics board provides a switching power amplifier to drive the motor, a digital interface on control and status lines, a write amplifier, and a read preamplifier. The units are $99 in original equipment manufacturer's (OEM) quantities.

Circle 542 on inquiry card.

Where Do New Products Items Come From?

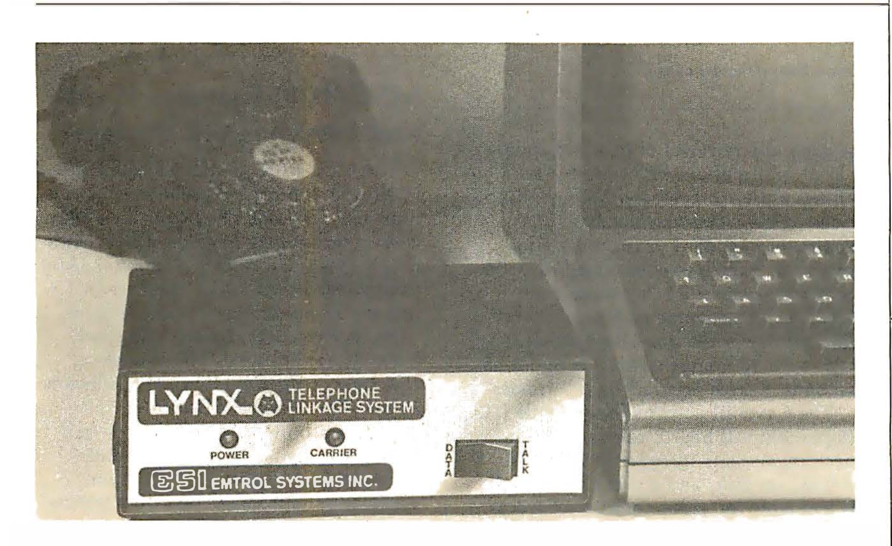
The information printed in the new products pages of BYTE is obtained from "new product" or "press release" copy sent by the promoters of new products. If in our judgement the information might be of interest to the personal computing experimenters and homebrewers who read BYTE, we print it in some form. We openly solicit releases and photos from manufacturers and suppliers to this marketplace. The information is printed more or less as a first in first out queue, subject to occasional priority modifications. While we would not knowingly print untrue or inaccurate data, or data from unreliable companies, our capacity to evaluate the products and companies appearing in the "What's New?" feature is necessarily limited. We therefore cannot be responsible for product quality or company performance.



Vector Graphic's MP Printer

The Vector Graphic MP is a 5-by-7 dot-matrix, software-driven printer that can print at a speed of 150 cps (characters per second). The price of the MP is under $1000 from Vector Graphic Inc, 31364 Via Colinas, Westlake Village CA 91361, (213) 991-2302.

Circle 543 on inquiry card.



Direct-Connect Modem for the TRS-80

Emtrol Systems Inc, 1262 Loop Rd, Lancaster PA 17604, (717) 392-2105, has introduced Lynx, a direct-connect telephone modem for the TRS-80. Lynx connects with the TRS-80 keyboard and the telephone line—no acoustic coupler is used. It includes originate and answer capability, and is programmable for word length, parity, number of stop bits and full- or half-duplex. The minimum requirements are a TRS-80 Level I or II with at least 4 K bytes of programmable memory. The Lynx is priced at $239.95.

Circle 544 on inquiry card.

Coosol's Printer Kits

Coosol has announced the availability of its 40-column friction-feed and 80-column tractor-feed dot-matrix impact printers in kit or assembled-and-tested forms. The units are microprocessor-controlled and programmable with thirty-two system-level software commands. They feature graphics dot-plotting mode, ninety-six ASCII (American Standard Code for Information Interchange) characters with uppercase and lowercase, nine software-selectable sizes, reverse-font printing capability, parallel and serial interfaces, data rates from 110 to 9600 bps (bits per second), and adjustable tractor width for paper size selection. Prices for kits are $295 for the 40-column and $455 for the 80-column printer. Assembled and tested impact printers are $325 for the 40-column and $485 for the 80-column, both without enclosures. For further information, contact Coosol Inc, 1585-200 Adams Ave, Costa Mesa CA 92626, (714) 545-2216.

Circle 545 on inquiry card.

Music Synthesizer for the H-8 from Heath

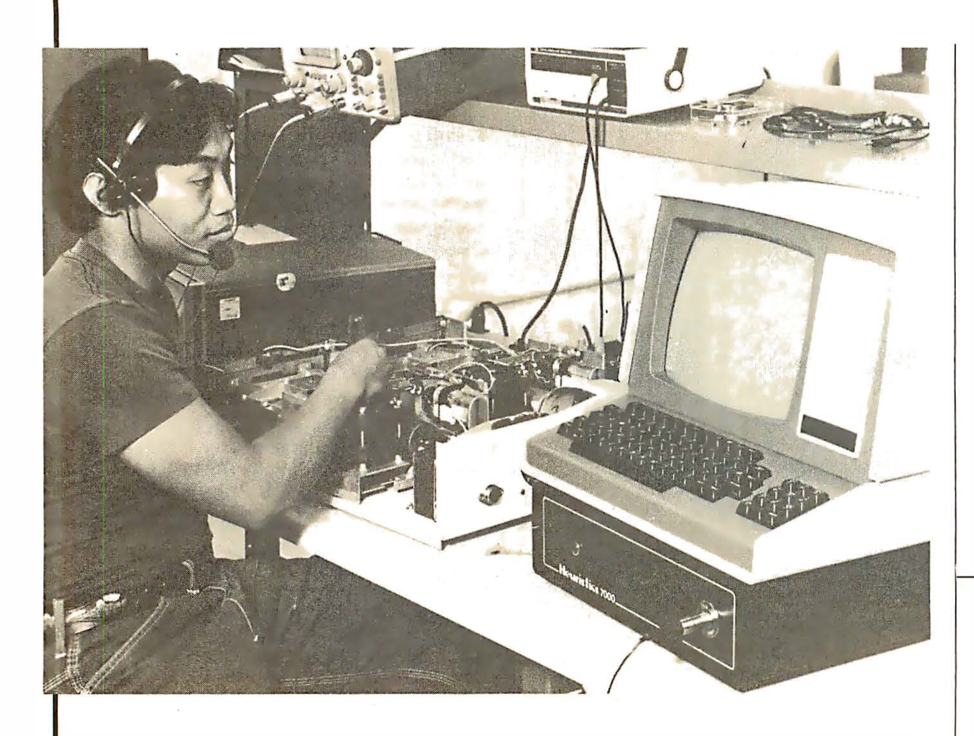
The Heath Company has introduced a music synthesizer system for the H-8 computer. The HA-8-2 music synthesizer system includes a circuit board and software. The software allows the user to enter any song into the system from conventional sheet music. The synthesizer board, which connects to any stereo system with two shielded cables, produces a 27.5 to 6600 Hz frequency response with up to nine harmonics. An H-8 with at least 24 K bytes of memory, a floppy-disk drive, and video terminal are required. The HA-8-2 is priced at $159 from Heath Company, Benton Harbor MI 49022, (616) 982-3210.

Circle 546 on inquiry card.

Storage Control Unit for the TI990 Bus

The ISC 4000 supports up to four 14- or 29-megabyte Shugart Winchester disk drives. The unit will also support floppy-disk or high-density tape backup devices. Compatibility with Texas Instruments' TI990 software is maintained by emulating existing TILINE bus devices. A complete 29-megabyte system, including a floppy disk, sells for $7000 from Data Management Labs, 2148 Bering Dr, San Jose CA 95131, (408) 946-9424.

Circle 547 on inquiry card.

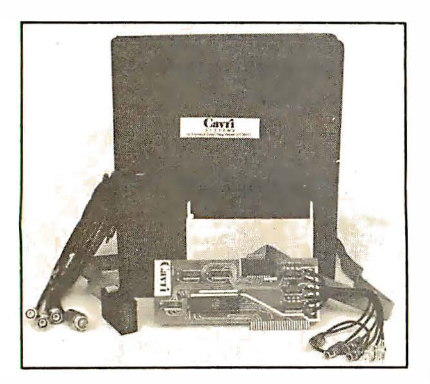


Speech Recognition Unit

The Heuristics 7000 speech recognition unit, which sells for approximately $3000, will interface with all RS-232 terminals. The 7000 enables users to enter information into their computers directly and with few errors. By eliminating the need for hand entry, busy businesspeople and the handicapped will benefit. The unit can recognize up to sixty-four words or phrases, each up to 3 seconds in length, and it is compatible with all common programming languages. It enables computers to take keyboard or voice input, or both simultaneously. The 7000 comes with a noise-cancelling headset microphone. Contact Heuristics, 1285 Hammerwood Ave, Sunnyvale CA 94086, (408) 734-8532.

Circle 548 on inquiry card.

Interactive Video



The Cavri III computer/video player integrator enables users to index and later access videotape frames or segments or to interact with videotaped materials. In addition to integrating computer-aided instruction with videotape, the system is useful for storage and retrieval of text and audio-visual information. The system also allows a user to control all remote functions of the video machine from the computer keyboard or from within a program. Access time to a desired point on a video cassette is less than 5 seconds. The average time required to find randomly distributed segments of tape on a 30-minute cassette is about 45 seconds. Search accuracy is ±7 frames.

The Cavri III consists of an Apple I/O (input/output) board, cables and connectors, systems software in Applesoft BASIC on disk, and a user's manual. It is available for video cassette recorders that carry a control pulse or that interface with manufacturers' search units. Users can convert already made videotapes, produce new tapes, or arrange to have Cavri produce materials. For information, contact Cavri Systems Inc, 26 Trumbull St, New Haven CT 06511, (203) 562-9873.

Circle 549 on inquiry card.

Floating-Point Board for the Apple

Increased speed is now available for the Apple II. The Computer Station Am9511 fast floating-point processor board plugs into the Apple II and relieves it of the task of doing transcendental functions in software. Instead, it uses a version of the standard floating-point BASIC, called Applefast, that allows the user to run existing programs without modifications. Taking 5000 square roots normally takes 250 seconds running Applesoft, but with Applefast it takes 15 seconds. Details can be obtained from Computer Station, 12 Crossroads, Granite City IL 62040, (618) 452-1860.

Circle 550 on inquiry card.

Reduce the Cost of Memory for the PET

The PH-001 2114 programmable memory adapter for the 2001-8 PET allows the use of lower-cost 2114 programmable memory integrated circuits to replace one to eight of the 6550's 1 K by 4 circuits used in the 8 K-byte PET. The board alone is $8.95, and the entire unassembled kit is $13.95, or $24.95 assembled. Contact Optimized Data Systems, POB 595, Placentia CA 92670, (714) 996-3201.

Circle 551 on inquiry card.

MSC-8100 Features Hard- and Floppy-Disk Storage

The MSC-8100 system incorporates an intelligent controller/formatter with a universal IEEE-488 bus protocol, a Winchester technology hard-disk drive with a 19.1-megabyte capacity, and a backup floppy-disk drive with a capacity of 1.6 megabytes per disk. The MSC-8100 is useful for word-processing and small-business applications. The average access time of the hard-disk drive is below 30 ms. The controller features a full-sector data buffer, error detection and correction, error recovery including automatic retry, automatic position verification, automatic seek to alternate track, parallel or serial interrupt, relative sector addressing, programmable sector interleaving, implied seeks, and more. Self-testing diagnostics are also provided. The MSC-8100 is priced at $9250. For information, contact Microcomputer Systems Corporation, 432 Lakeside Dr, Sunnyvale CA 94086, (408) 733-4200.

Circle 552 on inquiry card.

What's New?

MISCELLANEOUS

Pensée Pascal Computer

Computer Interface Technology's Pensée system is a stack-oriented, 16-bit computer with a dual floppy-disk subsystem capable of storing up to 2 megabytes. It features 64 K bytes of programmable memory; floating-point hardware; floppy-disk controller; 8-inch single- or double-sided, single- or double-density floppy-disk drives; two serial RS-232 asynchronous/synchronous ports; two unidirectional 8-bit parallel ports; and self-test diagnostics. Pensée utilizes the UCSD Pascal operating system version III.0, which includes the Pascal compiler, BASIC compiler, file manager, screen-oriented editor, and debugger. Some UCSD language extensions are also included. Prices range from $3500 to $9000, depending on peripheral subsystems. Obtain information from Computer Interface Technology, 201 W Dyer Rd, Santa Ana CA 92707, (714) 979-9920.

Circle 553 on inquiry card.

Peelings

Peelings is devoted exclusively to reviews of software for the Apple II and Apple II Plus microcomputers. Each bimonthly issue contains reviews of twelve to fifteen programs or software packages. Subscriptions are $15 from *Peelings*, Ed Burlbaw, 945 Brook Cr, Las Cruces NM 88001, (505) 523-5088.

Circle 554 on inquiry card.

The Flex-File System

The Flex-File is a nonglare vinyl page having pockets on each side to house two 8-inch floppy disks plus a center pocket to store 22 by 28 cm (8.5 by 11 inch) paper, computer printouts, or other documentation. The pages are three-hole punched for storage in standard three-ring binders. Flex-File pages are priced at $8.95 for a package of ten pages and are available from BIS Inc, POB 969, Brentwood TN 37027

Circle 555 on inquiry card.

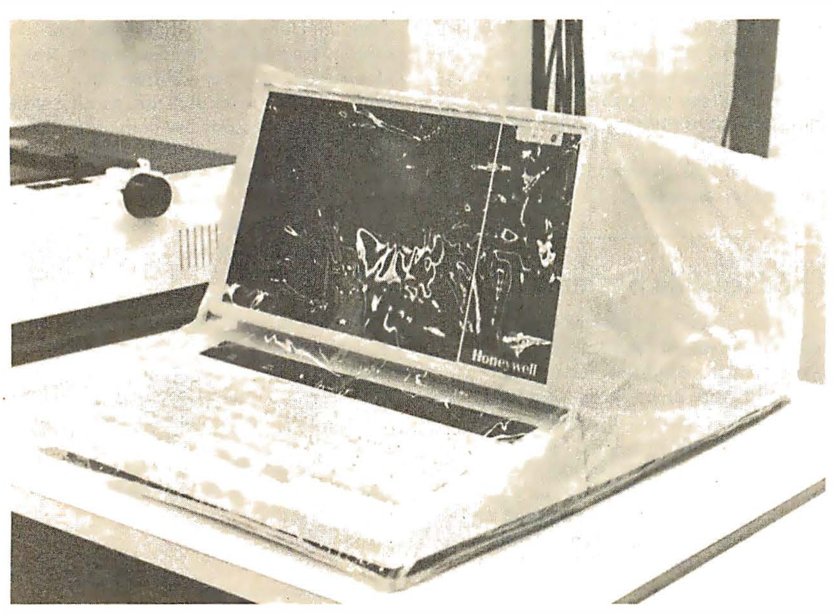
Elementary Math Edu-Disk

The Elementary Math Edu-Disk contains an arithmetic-readiness test and four interactive lessons designed to teach elementary addition, subtraction, multiplication, and division, in nine skill levels. These lessons use color graphics and a computer-simulated voice to maintain student interest and reinforce basic concepts. The student's scores are maintained on disk and are accessible only through a special teacher's program. The system is self-demonstrating and is recommended for the student with no prior arithmetic experience, and as a supplement in higher-level remedial situations. The requirements for the program are an Apple II computer with 48 K bytes of programmable memory with Integer BASIC. The price for the program is $39.95, from Muse Software, 330 N Charles St, Baltimore MD 21201, (301) 659-7212.

Circle 556 on inquiry card.

MISCELLANEOUS

Dust Covers for Computer Terminals



These dust covers are designed to protect video terminals, printers, and keyboards from dust and dirt. They are made of heavy-gauge clear plastic that will protect against water damage. The covers are custom made to fit any specific model of computer terminal, keyboard, or printer for all computer systems. When ordering, specify the system being used. The price for a cover for a video terminal including keyboard is $9.95. For a keyboard only, it is $8.95, and for a printer it is $9.95. For details, contact The Computer Accessories Company, 20 Boat Ln, Port Washington NY 11050, (516) 767-0366.

Circle 557 on inquiry card.

Burst-Error Processor from AMD

Advanced Micro Devices (AMD) has announced a general-purpose burst-error processor (BEP). This LSI (large-scale integration) device, the AmZ8065, can detect and allows correction of up to 12-bit burst errors in serial data streams moving at up to 20 million bps (bits per second). The codes implemented in the BEP include 48- and 56-bit polynomials used by IBM and 32- and 35-bit polynomials favored by minicomputer manufacturers. The BEP provides two read modes, normal and high-speed, that determine the correction methodology if an error is found. The AmZ8065 user can select the correction method based on the Chinese Remainder Theorem. This method computes the error location and the correction needed. The BEP employs a reciprocal polynomial that approaches the data stream from the check-bits side. This reduces worst-case correction time to the length of the data stream. The device accepts data as serial bytes which allows a single-phase clock requirement of 2.5 MHz. It operates from a single +5 V supply and comes in a 40-pin integrated circuit. Prices start at $69 each in one hundred-unit lots. Contact Advanced Micro Devices Inc, 901 Thompson Pl, Sunnyvale CA 94086, (408) 732-2400.

Circle 560 on inquiry card.

Accounts Receivable Program for the TRS-80

Radio Shack has an accounts receivable system for use on the TRS-80 Model I. Accounts receivable provides end-of-month billing, statements ready for mailing, automatic customer-record updating, totals for general ledger posting, optional message lines on billing statements, and full accounts receivable analysis including activity status, and more. Reports printed by this system are complete transaction file report, general ledger recap report, complete accounts listing, account listing by activity status, accounts receivable analysis by activity status, and posting report. A Model I Level II system with 16 K bytes of programmable memory, plus an expansion interface with at least 16 K bytes of programmable memory, an 80-column printer, and a minimum of two disk drives are required. The accounts receivable system is priced at $149.95 from Radio Shack dealers and stores.

Circle 558 on inquiry card.

Computer/Typewriter Interface

The I/O Pak from Rochester Data consists of an array of coils positioned in the same pattern as a typewriter's keyboard, in a unit that fits directly over the keyboard. These coils are wired into an electrical decoding matrix. The I/O Pak is designed to generate hard copy directly from a computer through any electric typewriter with a powered carriage return. No modification to the typewriter is required, and all adjustments to compensate for different key heights are incorporated in the I/O Pak. Available options include interfaces and software for the TRS-80 Level I and II, the Apple II, and a 6-bit parallel interface for general operation with other computers. Centronics-compatible and PET interfaces are also available. The I/O Pak retails for $469; the interface board and power supply required for packaged operation are priced at $145. Contact Rochester Data Inc, 3100 Monroe Ave, Rochester NY 14618, (716) 385-4338.

Circle 559 on inquiry card.

OKI 4 K Static Programmable-Memory Integrated Circuits

OKI Semiconductor, 1333 Lawrence Expy, Suite 401, Santa Clara CA 95051, (408) 984-4840, has introduced the MSM 2114L series of 4 K static programmable memory integrated circuits. The MSM 2114L, MSM 2114L-2, and MSM 2114L-3 are n-channel silicon-gate MOS (metal-oxide semiconductor) circuits that use fully static circuitry which does not require clocks or refreshing. The circuits are interchangeable with all standard 2114L parts and feature TTL-compatible (TTL is transistor-transistor logic) I/O (input/output), and a single +5 V power supply. They feature maximum access times of 200 ns for the 2114L-2, 300 ns for the 2114L-3, and 450 ns for the 2114L, and maximum power dissipation of 370 mW. Prices are $5.45 for the 2114L, $5.65 for the 2114L-3, and $6.75 for the 2114L-2. These prices are for 100-unit quantities.

Circle 561 on inquiry card.

What's New?

MISCELLANEOUS

Model 460 Paper Tiger Printer from IDS

The Model 460 addition to the IDS Paper Tiger family of printers produces letter-quality printing at a speed of 160 cps (characters per second). It also provides high-resolution graphics capability and includes proportional character spacing and automatic text justification. The Model 460 is a dot-matrix printer that utilizes a horizontal and vertical dot overlay to achieve letter-quality printing. It can print in 80-, 96- and 132-column formats. Foreign and custom character sets are optional and up to four 96-character sets can reside in the 460 at the same time. Paper-handling features include pin-feed tractor drives. A microprocessor provides an automatic test of the printer's memory and electronics each time the power is turned on, and a full character-set print capability test. A 2 K-byte buffer allows the Model 460 to accept the contents of a 1920-character video screen. The 460 has a standard RS-232C serial interface as well as a Centronics-compatible parallel interface. Serial transmission rates from 110 to 9600 bps (bits per second) are switch selectable. The Model 460 costs $1295 from Integral Data Systems, 14 Tech Cir, Natick MA 01760, (617) 237-7610.

Circle 562 on inquiry card.

Aspen Ribbons

Aspen Ribbons has announced the addition of four cartridge ribbons to its line of ribbon products. Aspen now manufactures Hytype I and II ribbons in nylon and carbon. Aspen molds its own cartridges by injection. Colors and private labels are available. The company also has a Wang multistrike cartridge ribbon and Qume 2 and 3 multistrike ribbons. For additional information, contact Aspen Ribbons, 1700 N 55th St, Boulder CO 80301, (303) 444-4054.

Circle 563 on inquiry card.

Music Synthesizer for the Apple

The Juke Box is a music synthesizer designed for any 48 K-byte Apple using Applesoft BASIC. It can produce three simultaneous voices and one channel of white noise. Pitch, rhythm, tempo, attenuation, and envelope can be selected and controlled for each voice independently from the other channels. The synthesizer has a five-octave range. Each card has an on-board amplifier capable of directly driving an 8-ohm speaker. As many as six cards can be installed to generate a total of eighteen notes. Multiple boards can create stereophonic, quadraphonic, and polyphonic operation. The devices can be daisy-chained to create more voices per speaker. A graphics music editor is also provided so the music can be seen and heard as it is input and edited. The price for the Juke Box is $129.95. Contact American Micro Products Inc, 705 N Bowser, MS 107, Richardson TX 75080, (214) 238-1815.

Circle 564 on inquiry card.

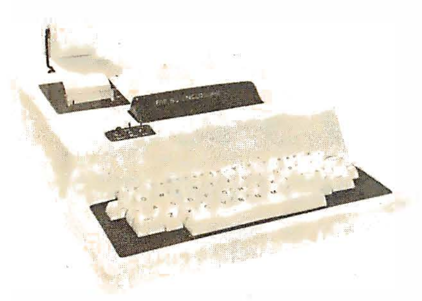
MISCELLANEOUS

OSI C1P Superboard II Modification Kit

The Super-Mod Kit provides a 48-character by 26-line video display and software selection of 300 or 1200 bps (bits per second) for cassette and RS-232 operation. The kit also provides an RS-232 port, start and stop control of the cassette, and doubling of system clock speed. Voice cuing and a listening function can be added. The kit contains all parts and documentation. Among the kit's contents are a regulated multiple-voltage power supply, a programmed monitor PROM (programmable read-only memory) compatible with all existing Ohio Scientific Instruments' functions and capable of formatting the video display with screen clear function callable under BASIC or assembly language, and sample programs. The price is $95 from A H Systems Inc, 9710 Cozycroft Ave, Chatsworth CA 91311, (213) 998-0223.

Circle 565 on inquiry card.

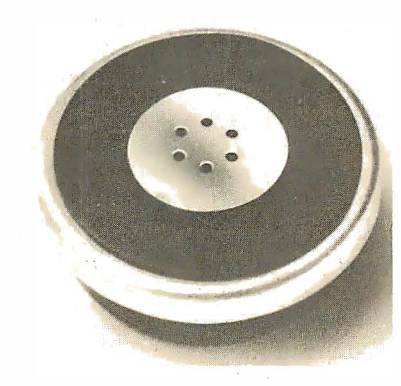
AIM-65 Enclosure



This enclosure is designed for the AIM-65 microcomputer. It is made out of high-strength ABS plastic and comes with mounting hardware, wire, and switches. All parts are pre-cut and drilled, and there is room for two additional boards. The color is white with a blue base. The enclosures are $49.95 plus $2.50 for shipping and handling. Contact Don-El Enterprises, 3261 Michigan Ave, Costa Mesa CA 92626, (714) 546-7481.

Circle 566 on inquiry card.

Modem Microphone from Novation



Super Mike was engineered specifically to eliminate data-distorting second harmonics. This Federal Communications Commission (FCC) registered microphone slips into your telephone handset, replacing the existing carbon microphone. The device eliminates the carbon granule packing problems that can cause a difference in reproduction level from telephone to telephone. Priced at $9.95, Super Mike is available from hobby stores, retail electronic outlets, and industrial distributors. For complete information contact Novation, 18664 Oxnard St, Tarzana CA 91356, (213) 996-5060.

Circle 567 on inquiry card.

The Nobus-Z

The Nobus-Z contains a 4 MHz Z80A microprocessor, the CP/M operating system, 64 K bytes of dynamic programmable memory, dual-density 8-inch floppy-disk drives with 600 K bytes per side, and a 6 K-byte color text and graphics feature. Console configurations range from a keyboard and television set to separate word-processing display terminals. A typical 70 K-byte system with 600 K bytes of disk storage costs under $3000. For more information, contact Exo Electronics Company, POB 3571, Culver City CA 90230, (213) 390-6527.

Circle 568 on inquiry card.

AIM-65 Expansion

The Memory-Mate, a 16 to 48 K-byte programmable-memory expansion board offers AIM-65 expansion for development system and process-control applications. The memory is assignable in 4 K blocks, with each of the blocks positionable anywhere in the system. The board also features full parity check circuitry and includes protection for AIM's 4 K on-board programmable memory. Another feature is programmable write protection in 4 K blocks. Four 8-bit bidirectional, 6522-type I/O (input/output) ports are included on the board. In addition, the board includes a programmable tone generator for audible warnings and sockets for up to 4 K PROM (programmable read-only memory). Price of the Memory-Mate with 16 K bytes of storage, connector to AIM, and manual is $475. Write AIM-Mate Series, Forethought Products, 87070 Dukhobar Rd, Eugene OR 97402, (503) 485-8575.

Circle 569 on inquiry card.

Floppy Disk Insurance?

Micro Lab has instituted a new plan for microcomputer users: Micro Lab Disk Insurance. The policy is being offered with the purchase of its Data Factory product line. The package is sold to the user with two locked versions of the master disk. If a master disk becomes damaged during the policy period, the policyholder may return the inoperative copy to Micro Lab for immediate free replacement. Users can switch to the backup master disk without any break in service. In addition, if an update in the program should occur, users will be notified, and the older versions will be revised at no cost. The policy sells for $17.50 per year. The Data Factory, a data-base management system, is offered in Applesoft and other forms. The program can run with one or two disk drives, but needs 48 K bytes with Applesoft in read-only memory. Information can be obtained by writing or calling Micro Lab, 811 Stonegate Dr, Highland Park IL 60035, (312) 433-7877.

Circle 570 on inquiry card.

The PMC-80—Compatible with the TRS-80

Personal Micro Computers Inc, 475 Ellis St, Mountain View CA 94043, (415) 968-1604, is offering a software- and hardware-compatible equivalent of the Radio Shack Model I, Level II TRS-80. The PMC-80 has a cassette tape recorder, 16 K bytes of programmable memory, Level II Microsoft BASIC interpreter in ROM (read-only memory), a power supply, computer, and keyboard. The system will display on either a television monitor or on a television set using a built-in VHF channel 3 modulator. All software available for the TRS-80 will operate in the PMC-80. Level II BASIC or SYSTEM cassettes will load in the PMC-80 without volume adjustments. All peripherals designed for the TRS-80 parallel port interface to the PMC-80 through an interface adapter available from the company. The price for the PMC-80, according to the manufacturer, is about $200 less than a comparably equipped TRS-80.

Circle 571 on inquiry card.

What's New?

MISCELLANEOUS

Multibus-Compatible Multimemory Board

A Multibus-compatible memory module that can accommodate industry-standard ROMs (read-only memory), EPROMs (erasable programmable read-only memory), and static programmable-memory integrated circuits in any combination is available from Artec Electronics Inc, 605 Old County Rd, San Carlos CA 94070, (415) 592-2740. The board contains sockets and memory interface logic for up to sixteen twenty-four-pin memory devices. It can contain a maximum of 64 K bytes of EPROMs or 32 K bytes of static programmable-memory circuits. The board can operate with only one socket filled. Memory addresses are independently assigned for each socket with wire-wrap jumpers. Any multiple of 1 K bytes can be addressed within a 64 K-byte address space. Memory access time is wire-wrap selectable. The low-power interface circuitry contains inhibit logic for each of two banks of eight memories. The multimodule board can interface with any 8-bit Multibus-compatible microcomputer. The price of the board is $175, not including memory circuits.

Circle 572 on inquiry card.

Printer from Matchless

The MS-204 printer is compatible with the TRS-80, Apple, PET, or any Centronics-type system. This 132-column, bidirectional, 9-by-7 dot-matrix printer has a printhead life of 100 million characters. Among the features are a print speed of 125 cps (characters per second) and throughput print speed of 63 lines per minute. The adjustable sprocket feed mechanism allows the use of forms from 6.4 to 24 cm wide (2.5 to 9.5 inches), with loading from either the bottom or rear. Uppercase and lowercase characters are provided. The printer provides preprogrammed and programmable tab postions, and top of form and bottom of form functions. The retail price is $795 from Matchless Systems, 18444 Broadway, Gardena CA 90248, (213) 327-1010.

Circle 575 on inquiry card.

PDP-11 FORTH

This FORTH system runs on any PDP-11 or LSI-11 microprocessor and requires less than 24 K bytes of memory. The floppy disk contains an RT-11 directory with FORTH in Macro-11 source, with extensive comments; this source can be assembled and run under RT-11, or under RSX-11M, or stand-alone, with or without EIS. The disk is single-density, but will run on a dual-density drive under RT-11. PDP-11 FORTH implements the FORTH Interest Group (FIG) language model, with full-length names to 31 characters, and extensive compile-time checks. In addition, an editor, a FORTH assembler, and a string package in FORTH source, are included. The system on disk, the *PDP-11 FORTH User's Guide*, *A FORTH Primer*, *FORTH Introduction Reprints*, an installation manual, and an assembly listing comprise the entire system. The cost is $140 from John S James, POB 348, Berkeley CA 94701, (415) 526-8815.

Circle 576 on inquiry card.

Desk-Top Calculator with a Voice

The Model SP1260-D, a talking calculator from Canon, is expected to be used in general business offices, banks, brokerage houses, schools, hospitals and factories. The unit's speech synthesizer is used when the operator wants to check entries on the roll paper. The voice feature eliminates the need for two employees to check lists of numbers. The calculator can store up to 128 items of data, including the final result of the input. The SP1260-D incorporates the voice feature, a 12-digit capacity, memory for accumulating results, item counting, decimal point selection, and more, for $399. Contact Canon Calculator Division, Canon USA Inc, 10 Nevada Dr, Lake Success NY 11042.

Circle 573 on inquiry card.

All-CMOS Single-Board Microcomputer

Pacific Cyber/Metrix Inc, 6800 Sierra Ct, Dublin CA 94566, (415) 829-8700, has announced availability of an all-CMOS (complementary metal-oxide semiconductor) single-board microcomputer capable of plugging directly into the Intel-originated Multibus card cage. The PPS-1201 features a CMOS 6100 microprocessor, 4 K bytes of memory that can be configured as any combination of CMOS programmable memory and CMOS EPROM (erasable programmable read-only memory), a programmable real-time clock, memory expansion controller, three 12-bit-wide parallel ports, and a single serial port. Also included is a transparent 1 K-byte monitor and debugger plus a binary bootstrap for loading on-board programmable memory through the serial port. The 6100 microprocessor employs a binary instruction set identical to that of the Digital Equipment Corporation PDP-8 and VT-78 DECstation minicomputers, so software development can be carried out on any of these machines. The price for the 1201 is $995.

Circle 574 on inquiry card.

What's New?

PUBLICATIONS

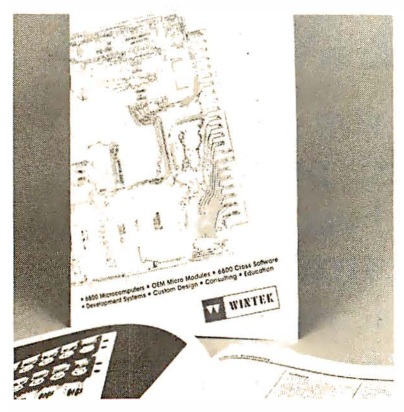
Report on Personal Computers Covers Trends, Systems, Software, and Vendors

Datapro Research Corporation's *All About Personal Computers*, traces the development of personal computers, discusses the future of the devices, and outlines how to buy a system. Also featured are reports on fifteen of the top personal computers, plus directories listing vendors of computers, software, peripherals, and publications. *All About Personal Computers* is available for $25 from Datapro Research Corporation, 1805 Underwood Blvd, Delran NJ 08075, (609) 764-0100.
Circle 577 on inquiry card.

Report on Voice Processing

The technologies of speech recognition and speech synthesis have been implemented into computer systems and have been employed in transportation, quality control, auto assembly, bank deposit transfer, and consumer products. In the April 1980 issue of *Data Entry Awareness Reports*, MIC (Management Information Corporation) discusses the voice-processing state of the art, its applications, and how to use it. This report is available to subscribers of *Data Entry Awareness Reports* or can be purchased separately by check for $15. Contact *Voice Processing Report*, Management Information Corporation, 140 Barclay Center, Cherry Hill NJ 08034, (609) 428-1020.
Circle 578 on inquiry card.

A Catalog from Wintek



A catalog containing information and specifications on Wintek's Sprint 68 development system/control computer with Wizrd multitasking DOS (disk operating system), macro editor, assembler, C compiler, 12 K BASIC, and 4 K industrial BASIC, is now available. The catalog also discusses alternatives for software development, Wintek's design and educational services, and cross software products. Contact Wintek Corporation, 1801 South St, Lafayette IN 47904, (317) 742-8428.
Circle 579 on inquiry card.

Computer Selection Handbook

Written specifically for small businesses and consultants, the *Computer Selection Handbook* presents a nontechnical method for selecting computer systems. This book concentrates on the practical and business aspects of choosing the right computer for your small business. The *Computer Selection Handbook* explains how to document small-business computer needs, solicit and evaluate vendor proposals, make the selection decision, and manage the installation and operation of the new system. The handbook is available directly from Decision Resources Corporation, 28203 Ridgefern Ct, Rancho Palos Verdes CA 90274, (213) 377-3533, for $35.
Circle 580 on inquiry card.

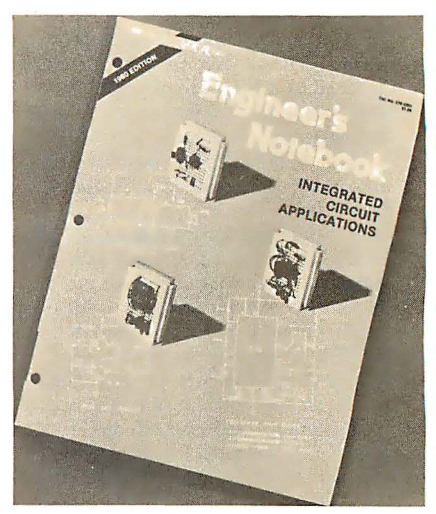
BASIC Training for Compucolor Computers

BASIC Training for Compucolor Computers, by Joseph J Charles, is intended for beginning users of the Compucolor II computer and is designed to serve as an introduction to Compucolor II BASIC. There are over 100 example programs and dozens of exercises in the book. The topics covered include the first steps of entering and listing programs, BASIC statements, functions, graphics, random-access files, flow-charting, subroutines, and more. The price of the book is $14.95, and it is available from Joseph J Charles, Dept B, POB 750, Hilton NY 14468.
Circle 581 on inquiry card.

Back Issues of Dr Dobb's Journal

Dr Dobb's Journal of Computer Calisthenics and Orthodontia: Running Light Without Overbyte, volumes 1, 2, and 3, are available from Hayden News. Almost everything from all issues of *Dr Dobb's Journal* for a particular year have been gathered into these volumes. They are priced at $18.95 each from Hayden Book Company, 50 Essex St, Rochelle Park NJ 07662, (201) 843-0550.
Circle 582 on inquiry card.

Archer Engineer's Notebook



Radio Shack has published a handbook of 415 electronic circuits for electronics hobbyists, experimenters, technicians, and engineers. Applications are included for most of the integrated circuits sold by Radio Shack. Dozens of problem-solving circuits are described. Tips and techniques for beginners are included. The book is divided into two major sections: digital and linear. It was compiled and hand-executed by Forrest M Mims III. The Archer *Engineer's Notebook* is available from participating Radio Shack stores and dealers for $1.99.
Circle 583 on inquiry card.

AIM-65 Newsletter from Rockwell

A newsletter for owners of AIM-65 microcomputers is available on a subscription basis from the Newsletter Editor, Rockwell International, POB 3669, RC55, Anaheim CA 92803, (714) 632-2321. *Interactive* responds to readers' questions, publishes articles by users, reports on the activities of AIM-65 users groups, and supplies articles on novel applications. The cost is $5 for six issues.
Circle 584 on inquiry card.

BITS Catalog

The fall issue of the BITS catalog is available. BITS is a distributor of computer publications located at 25 Rt 101 W, POB 428, Peterborough NH 03458, (603) 924-3356. This catalog features publications from BYTE, Osborne/McGraw-Hill, Scelbi, and others. The catalog is priced at $0.50.
Circle 585 on inquiry card.

What's New?

PUBLICATIONS

Health Planning Publication

Hapenney Associates has announced a publication entitled *Data Bits*. It is written for health planners, and is designed to coordinate the data and automation efforts of health planners within the 205 health-systems agencies and 51 state health planning and development agencies in the US. It examines technological advances in automated data processing that may affect health planners. Items of interest regarding happenings at the federal level are provided, as well as information regarding current activities of different agencies. *Data Bits* is published monthly. Subscriptions are available at $60 per year. Single issues are $5 per copy. Contact the Assistant to the Editor, POB 1076, Columbia MD 21044, (301) 596-0874.

Circle 586 on inquiry card.

User Ratings of Computer Systems

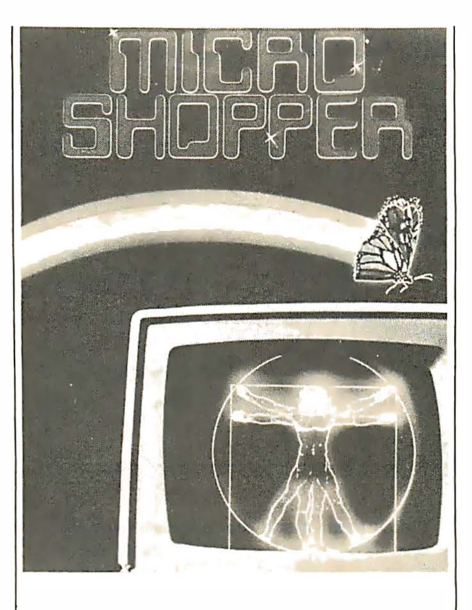
User Ratings of Computer Systems, from Datapro Research Corporation, 1805 Underwood Blvd, Delran NJ 08075, (609) 764-0100, details the results of a survey of 14,900 computer users that produced 4614 usable responses that provided ratings of 7871 installed systems from sixty-four vendors, along with information on applications, software, languages, problems, and future user plans. The survey covers personal computers, mainframes, minicomputers, and small-business computers. The report also includes summaries of ratings for various software applications, which languages are most commonly used on different systems and configurations, and how users felt about documentation for systems. Copies are available for $25.

Circle 587 on inquiry card.

Bulletin on DC-to-DC Power Supplies

A data sheet introducing a selection of thirty new 5 and 6 watt, DC-to-DC power supplies is available from Sola Electric, 1717 Busse Rd, Elk Grove Village IL 60007, (312) 439-2800. The low-profile switching converters are designed for printed-circuit board mounting. Specification charts provide basic technical data, operational and physical descriptions.

Circle 588 on inquiry card.



The MicroShopper Guide to Microcomputers

MicroShopper 80: The New Computers is a 192-page business and personal guide to microcomputer hardware and software, published by P G I Publishing, a division of The Phoenix Group, 1425 W 12th Pl, Tempe AZ 85281, (602) 967-1421. This fifth edition features photographs of microcomputer systems, peripherals and accessories, plus industry literature from more than 100 manufacturers representing over 500 products. It is designed for first-time computer users, consultants, dealers, and data-processing professionals. Definitions, explanations, and reviews of equipment are provided. *MicroShopper* is priced at $9.95 retail or $11 including postage and handling, direct from P G I.

Circle 589 on inquiry card.

TRS-80 Supply Catalog

The TRS-80 DOSHS (Directory of Software, Hardware, and Services) is designed to help users locate software, hardware, and support services for the TRS-80 microcomputer. The catalog contains hundreds of listings for S-100 adapters for the TRS-80, books, color-graphic units, TRS-80 units, consulting services, floppy disks, expansion interfaces, RS-232 interfaces, light pens, lowercase modification kits, magazines, newsletters, plotters, printers, rentals, repair services, speech synthesizers, and more. It is available for $6 from Pen-Ter Research, 9633 Rosehill Rd, Lenexa KS 66215.

Circle 590 on inquiry card.

International Directory of Software

The International Directory of Software is a one-volume directory featuring over 3200 independently marketed software products available from American and European suppliers. Each product is indexed within as many as five categories. Systems and applications software are listed in the directory under a total of 107 categories, including communications, compilers, data management, development aids, systems software for mainframes, systems software for microprocessors, utilities, accounting, administration, production and distribution, modeling, and other categories for various specialized applications software. Data on each product describes its date of origin, installed base, function, terms for purchase or leasing, operational mode, configuration requirements, and the names and addresses of suppliers worldwide. *The International Directory of Software* is priced at $140. Contact CUYB Publications Inc, First Federal Bldg, Suite 401, Pottstown PA 19404, (215) 326-5188.

Circle 591 on inquiry card.

The BOOK: Accessing the TRS-80 ROM, Volume I

The BOOK is the first of three volumes on machine- and assembly-language access to the Level II BASIC ROM (read-only memory) in the TRS-80 Model I microcomputer. This volume details the mathematic subroutines and data formats. A fully commented listing of these routines is provided. Included in the book is a memory map of the entire machine that provides descriptions of over 500 memory locations. *The BOOK* is available at computer stores or from Insiders Software Consultants, POB 2441, Springfield VA 22152, (703) 960-2998, for $14.95 plus postage and handling.

Circle 592 on inquiry card.

Catalog from OK Machine and Tool Corporation

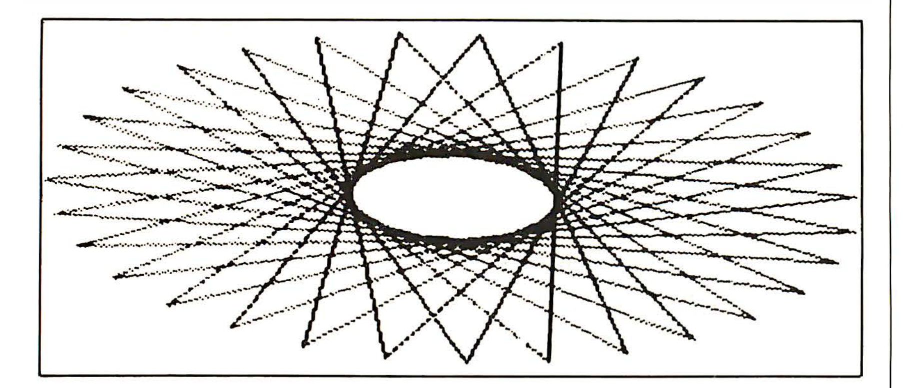
This catalog from OK Machine and Tool Corporation, 3455 Conner St, Bronx NY 10475, (212) 994-6600, features numerous wire-wrap tools and supplies, controllers, tape readers, circuit boards, and other items for homebrewers. A price list is also available.

Circle 593 on inquiry card.

What's New?

SOFTWARE

High-Resolution Package for the AIM-65



The MTU K-1009-1C Text/Graphics Printout program permits the AIM-65 to print text and high-resolution graphics without modifications to the computer or the printer. The contents of the AIM-65 text buffer are reproduced as ten lines of up to 127 characters per line. The display is created as a 320-by-200 dot matrix. The program provides the Quick Print mode that generates the image on one paper strip, and the Quality Print mode that generates the image as two 320-by-100 strips to be taped together. The program is priced at $25 from Micro Technology Unlimited, 2806 Hillsborough St, POB 12106, Raleigh NC 27605, (919) 833-1458.
Circle 594 on inquiry card.

Genealogy Program

AppleRoots is a genealogy software package that can be used for human or animal genealogy. It has seventeen user-definable fields. Functions include system initialization; record entry, change, delete; print index or records; print list of children, family records, or four-generation pedigree chart. All printer functions can be displayed on the screen or sent to the printer. All functions are menu-oriented and no programming is required to customize the system for personal use. The package is written in Applesoft and requires one disk drive and an Apple II with 24 K bytes of programmable memory. The system sells for $39.95 from Computer Data Systems Corporation, 695 E 10th N, Logan UT 84321, (801) 753-6990.
Circle 595 on inquiry card.

Educational Software

Educational Software, 801 E 6th Ave, Helena MT 59601, developers of educational software for the preschool thru eighth grade student, has announced a line of programs for the home-computer user. The programs provide positive feedback and cover a wide group of subjects for the young home-computer user. The programs measure the user's performance during each session and are designed for easy modification by the consumer.
Circle 596 on inquiry card.

XYBASIC Interpreter for 8080, 8085, and Z80 Systems

XYBASIC is a language designed specifically for measurement and process control. It offers the standard features of BASIC plus machine-language linking, software interrupts, and bit manipulation commands. Versions are available for SBC/80, CP/M, ISIS-II, Intellec 8 Mod 80, and MDS-800 systems. The nonstandard XYBASIC versions, with a patchable I/O (input/output), make the language adaptable for 8080, 8085, and Z80 sytems.

By allowing XYBASIC and the user's program to be placed in ROM (read-only memory), a program can be developed on the target system, put in ROM, and run. This eliminates the problems of floppy-disk program storage in hostile environments. XYBASIC options include a 9511 version utilizing the floating-point circuit, an EDIT version providing edit commands, an extended disk version for use with CP/M systems, and a real-time clock version for SBC/80s. XYBASIC is available in integer or extended forms. Versions start at $350. Custom versions can be made. For information, contact Mark Williams Company, 1430 W Wrightwood, Chicago IL 60614, (312) 472-6659.
Circle 597 on inquiry card.

Apple Users Gain Access to Dow Jones News and Stock Quotes

Apple Computer Inc, 10260 Bandley Dr, Cupertino CA 95014, (408) 996-1010, has introduced the *Dow Jones News and Quotes Reporter*, a software package that puts Apple users in touch with financial news. The program retrieves, displays, and optionally prints selected news stories from the *Dow Jones News Service*, the *Wall Street Journal*, and *Barron's* magazine, plus it can list price quotations for more than 6000 securities.

The user gains access through a telephone and modem, and, to access news stories, the user selects News Retrieval Service from the menu. Once a password has been verified, the user can select a news category or company, scan a list of headlines about it, and view the story. Stock quotes can be gained in the same way. The system will run on an Apple II or Apple II Plus with a minimum of 48 K bytes of programmable memory. Also required are a 16-sector format Apple Disk II with a controller, a modem, a video monitor, and a telephone. A printer is optional. Owners will receive $25 of connection time when they purchase the package, which retails for $95.
Circle 598 on inquiry card.

CP/M Advanced BASIC Compiler

This compiler, called the Topaz Compiler, produces a relocatable object file that is auto-linked with several libraries to produce a CP/M-compatible .COM file. Two types of floating points are available as well as integer and a fixed-point format. The compiler supports REPEAT...UNTIL, WHILE...DO, IF...THEN...ELSE, BEGIN...END, and CASE...OF techniques. All structured statements may be nested. The compiler supports double- and single-precision floating point, fixed-point packed binary-coded decimal, integer, string and character data types. Disk files may use a packed binary format or an ASCII (American Standard Code for Information Interchange) storage format. Any .COM file can be loaded and executed from control of a BASIC program. Commands can be executed under program control after the .COM file is finished. The price is $249.95 from Midwest Digital, 863 Wood Ave, Wichita KS 67212, (316) 721-1671.
Circle 599 on inquiry card.

What's New?

SOFTWARE

Symbolic Dissassembler for 6809 Computers

The 6809 symbolic disassembler is written for users of the 6809 microprocessor. DISASM6809 is reentrant, able to be put in ROM (read-only memory), and position-independent. It is called as a subroutine once for each instruction to be disassembled. All necessary parameters, including the address of the user's output routine, are passed in registers. The disassembler can produce alphanumeric symbols in both the label and operand fields. Invalid op codes are detected. The program requires under 2 K bytes of space and uses approximately 32 bytes of memory on the calling stack. Output format is syntactically identical to Motorola's assembly-language definition. DISASM6809 is available as a commented assembly listing with instructions for $25. Contact C R Bilbe, 6933 Cedarwood Cir, Colorado Springs CO 80918.

Circle 600 on inquiry card.

Order-Entry Software Package for Small Businesses

Order Entry will handle the documentation and control of purchasing and sales. The information from Order Entry can be processed through the accounts payable, accounts receivable, inventory control, and general ledger programs from Compumax, updating these modules to reflect purchase and sales activity. Order Entry includes generation and printing of purchase and sales orders, computation of tax and registration of deliveries against outstanding purchase orders and of shipments against outstanding sales orders, along with complete purchase and sales order history reports. The program is available in Micropolis 1053/II (48 K), Apple II, PET (DOS 2.0), and Microsoft under CP/M versions. For further information, contact Compumax, POB 1139, Palo Alto CA 94301, (415) 321-2881.

Circle 601 on inquiry card.

Microsoft BASIC Interpreter for the Z8000

BASIC-Z8000 is an interpreter for the 16-bit Z8000 microprocessor. This interpreter uses an expanded internal notation that takes advantage of the Z8000's 32-bit instructions. The accuracy of internal calculations is in excess of eight digits for single precision and eighteen digits for double precision. Variables are stored using the proposed IEEE (Institute of Electrical and Electronics Engineers) standards, allowing for a double-precision range of exponents from −308 to +308. BASIC-Z8000 is fully language-compatible with Microsoft's BASIC-80 and -86 interpreters, Release 5.0. Microsoft BASIC progams can be run on the 8080, 8086, Z8000 interpreters without modification. Evaluation copies of BASIC-Z8000 may be purchased for $350 (extended) or $600 (disk), from Microsoft, 10800 NE 8th St, Suite 819, Bellevue WA 98004, (206) 455-8080.

Circle 602 on inquiry card.

Be a BYTE Author

With BYTE's recent growth, we are now able to offer you more of the best articles and features about personal computing. Since much of the information in BYTE is supplied by you, the reader, you now have an even better chance to be a **paid** BYTE author. Our current needs include:

- Articles: BYTE is always looking for well-written articles that cover the field of microcomputing.
- Hardware/Software/System Reviews: BYTE is expanding its review of hardware, software, and computer systems. We are looking for detailed, comprehensive reviews as well as short (one- to three-page) reviews.
- Technical/Education/Languages Forums: These forums allow readers to take a stand on various issues or to clarify points made in the magazine.
- Programming Quickies: Do you have a program you'd like to share as a Programming Quickie? Send it in with a page or two of explanation.
- Systems Notes, a new feature, is devoted to sharing both hardware and software tips and techniques that you've found useful for any microcomputer brand or homebrew design. We will pay $20.00 for short submissions and the standard BYTE rate for articles that are one typeset page or longer.

We are interested in material about the Apple, Radio Shack TRS-80, Commodore PET/CBM, Exidy Sorcerer, Atari, Ohio Scientific, Compucolor, Microsoft BASIC, CP/M, and S-100-bus computers, as well as other computer brands and homebrew designs. Undocumented information about a particular computer (eg: machine-language routine entry points) is also useful.

General Format and Treatment

All submissions, including letters and other nonpaid material, should be typed, double spaced, and on white paper. All listings should be computer printouts using a fresh ribbon and unlined white paper only. (Look closely at your printout to make sure that the typeface is as dark and solid as possible so that we can photo-reproduce it for the magazine printing.) Cassette tapes or 5-inch floppy disks are acceptable, as are 8-inch CP/M floppy disks. No unused submissions can be returned without a self-addressed envelope and sufficient postage.

We will accept or reject each submission within three months of receipt, four months for articles. Full payment for short submission or advance partial payment for articles and larger submissions will be sent with the letter of acceptance. Completing payment for articles and longer submissions will be sent at the time of publication. Standard BYTE payment, except where noted above, is $50 per magazine page of material.

We hope to hear from you soon.

Would you like to know more about being a BYTE author? If so, then send a large, stamped, self-addressed envelope to:

Author Information
BYTE Publications
70 Main St
Peterborough NH 03458

What's New?

SOFTWARE

Civil Engineering Package

The USA Civil Engineering package from Universal Software Applications Inc, 13001 Cannes Dr, St Louis MO 63141, (314) 878-1277, consists of three independent programs. The first is the USA COGO Civil Engineering Coordinate Geometry program that can be used for right of way surveys, highway design, bridge geometry, interchange design, construction layout, airport design, and other applications. Some of the COGO commands included are distance, locate/azimuth, locate/bearing, inverse/azimuth, points/intersect, azimuth/intersect, arc/line/points, arc/arc/intersect, area, simple/curve, and deflection/LS.

The second program is available for roadway design or subdivision design; it is entitled the USA Earth Design Earthwork Quantities program. It features independent input files for vertical curve, existing ground, proposed section, and design requirements files. Output is by section and includes the station, elevation of profile grade, assumed factors for cut and fill, area, volume and accumulated volume.

Finally, there is the USA Stress Structural Engineering Systems Solver which performs linear analysis of elastic, statically-loaded plane-framed structures. Structure, number of joints/members/loadings, joint coordinates, member incidences and properties, loading, member and joint loads, tabulate, solve, and stop, and a host of other commands are included. Output consists of the input structure data for each loading condition, the horizontal, vertical, and rotation components of deflection at each joint, the axial forces, shear forces, and moments at the ends of each member or optionally at interior points. The programs will run on Z80, 8080, and 6502 systems with a minimum of 32 K bytes of memory. The one-time lease price is $1000 for individual programs, $2250 for all three programs, and $1750 for any two.

Circle 603 on inquiry card.

Apple II Statistical Program

Rosen Grandon Associates has announced A-STAT 79, a general-purpose statistical package for the Apple II. The system is a subset language of the P-STAT 78 package for mainframe computers. The program can have as many as forty-five variables for each of 2000 cases. A-STAT is designed for market research, survey analysis, social and economic modeling, simulations, or teaching statistics. Statistical procedures include file definition and descriptive statistics, frequency distributions, bivariate frequency distributions, the ability to create square correlation matrices, multiple regression and path analysis of linear combinations of variables, permanent file modification, variable transformations, and descriptive statistics file production, and more. A-STAT runs on the Apple II or Apple II Plus systems with 32 K bytes of memory and Applesoft in ROM (read-only memory), or 48 K bytes and Applesoft software. One or more floppy-disk drives are required. It is priced at $100 from Rosen Grandon Associates, 296 Peter Green Rd, Tolland CT 06084.

Circle 604 on inquiry card.

COBOL for the TRS-80

Radio Shack COBOL can make the TRS-80 Model II compatible with many existing COBOL programs, including some written for mainframe computers. This development system offers multikey ISAM (index sequential-access method) files. Features include a one-pass compiler, full screen formatting, full ANSI (American National Standards Institute) Level 2 I/O (input/output), program linkage, and segmentation. The Radio Shack COBOL development system, with a reference manual, user's guide, sample program, and floppy disk is priced at $299 from participating Radio Shack stores and dealers, and Radio Shack Computer Centers.

Circle 607 on inquiry card.

polyFORTH-CP/M

polyFORTH-CP/M from FORTH Inc can run on nearly any 32 K-byte or larger CP/M-based system. The program resides on a CP/M floppy disk as a command file. When loaded, it finds and links up to the CP/M I/O (input/output) drivers, initializes itself, and responds "up" on the system console. The program runs in place of CP/M, utilizing only the CP/M I/O drivers. FORTH Inc's 8080 polyFORTH system on a floppy disk and a manual containing the interface material are provided. A CP/M utility that allows transferring polyFORTH blocks to a CP/M file and transferring a CP/M file to polyFORTH blocks is also provided. Source code is supplied for the entire system. polyFORTH-CP/M is available from M & B Design, 820 Sweetbay Dr, Sunnyvale CA 94086, (408) 243-0834, for $4750.

Circle 608 on inquiry card.

Inventory-Control System for Cromemco Computers

Feith Software has announced the release of its inventory-control system for manufacturers, wholesalers, and retailers. It is designed to run on any Cromemco- or CP/M-compatible system having dual floppy-disk drives, 48 K bytes of programmable memory, and a 132-column printer. It features parts explosions of finished goods and assemblies, automatic generation of pull sheets, and it will remove parts from stock after a production run. A full audit trail of inventory transactions is maintained. The capacity of the system on a double-density 8-inch floppy disk is over 2000 inventory items and 2000 transactions per disk. Reports are provided for economic order quantities, reordering, ABC analysis, and stock status. The package comes on an 8-inch floppy disk, with a manual and program listings for $250. For details, contact Feith Software, Cedarbrook Hills A-1103, Wyncote PA 19095, (215) 887-9780.

Circle 605 on inquiry card.

Z8000 Software from Hemenway

The RAZ8002ML resident assembler, which includes the LINKZ8002 linking loader, comprises a two-pass macroassembler and a one-pass linking loader. They are designed to run under Hemenway Associates Inc (located at 101 Tremont St, Suite 208, Boston MA 02108, (617) 426-1931) HA-CP/Z8000 operating system in a 32 K-byte system. The RAZ8002ML has full macroassembler facilities and conditional assembly of up to eight nested levels. It produces a listing and a sorted-symbol table that generates relocatable and linkable object code. The program uses a hash-coded symbol table and binary search of the mnemonic table, and it allows separately assembled routines to share data for production of programs suitable for ROM (read-only memory) circuits. All Zilog-defined op codes are recognized, and a set of pseudo-operation instructions is included. The program is priced at $350.

Circle 606 on inquiry card.

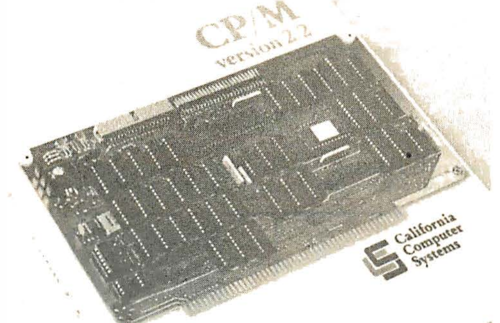
MULTIMODE FLOPPY DISK CONTROLLER

California Computer Systems

CCS-2422 $400.00

- Factory Assembled & Tested
- Based on Western Digital 1793
- IBM Format Compatible
- ROM Controlled Addressing
- Auto Boot
- Single and Double Density
- 5¼" and 8" Drives
- Write Precompensation
- Fast Seek if Voice Coil Type Drives
- Auto Eject (Persci)
- Read Data Separator
- Data Input Filtering
- Digital Data Separator
- 2K Byte EPROM (2716) for Auto Boot
- Auto Wait Port Select
- Led's to Indicate Boot, Select and Bank
- Four Drive Select Lines

FREE COPY OF CPM 2.2*



Drive Compatibility
Interfaces to both 5.25" and 8" double- and single-sided drives in any combination up to four drives total. Is bus-compatible with Shugart and Memorex 5.25" and 8" drives and can be made compatible with a wide variety of soft-sectored drives. For voice coil drives, fast seek operation can be either software or hardware enabled.

Disk Controller Chip
Uses the powerful Western Digital 1793 disk controller chip. This chip provides IBM-compatible single and double density formatting, performs the read data separation, provides comprehensive track and sector status information, etc.

Bank Select
Can be hardware-assigned to one of eight banks. Bank then software-selected by outputting bank select byte to port 40h. Bank-select system can be disabled entirely or just at power-on and reset so that board comes up enabled.

On-board ROM
Comes with on-board, 2K EPROM containing both monitor firmware and a bootstrap loader for loading CP/M from disk. Board can be configured to either load in CP/M on system, system power-on and reset or on a monitor command. After CP/M is loaded, monitor and bootstrap loader are disabled. The monitor firmware contains routines for reading and writing to/from disks, for dumping, moving, and changing memory, etc. ROM, when selected, generates the PHANTOM line for memory overlay. ROM's selection handled by address decoding ROM.

Accessible Registers
Internal to the 1793 are the Command, Status, Track, Sector, and Data registers. External are the board Control/Status registers 1 and 2. Control registers allow software specification of double or single density formatting, drive size, disk side, drive number, etc. Decoding of register addresses handled by ROM; optional ROM available for memory mapped I/O.

Wait State Generation
Software-enabled Auto Waits allow 2422 to force the CPU into a Wait state when data register is busy during either a board status register read or a data register read/write. User can select which register access generates Auto Waits. Board can also be set to request one Wait state per cycle in which the ROM is selected, or if user's system supports this feature, per cycle in which the ROM is selected and the CPU is operating at 4 MHz.

On-board Read Clock Generation
On-board circuitry supplies the controller chip with the Read clock signal it needs to perform read data separation.

Write Precompensation
Write precompensation provided for double density formatting.

Power Supply
Unregulated +8V, +16V, and -16V. Draws less than 1 amp at +8V.

Physical Description
Features reliable, easy-to-configure plug jumpers • Uses primarily low-power Schottky devices • Sockets for all ICs • Solder-masked on both sides • Gold-plated edge connector fingers • Silkscreen of component outlines, reference numbers, and part designations.

LOBO DISK DRIVES

LOBO 8" DISK DRIVE CABINET

New from Lobo, a dual Cabinet with power supply and internal data cable hook-up.

- Cabinet accepts 2 801R, 800R, FD120, or FD200 style disk drives.
- Power Supply for 2 drives.
- Assembled, tested and guaranteed by Lobo Drives
- Shipping Weight 30 lbs.

LBO — DUAL 8 PCS $329.00

Cabinet only — no power supply or internal data cable

LBO — DUAL 8 C $59.95

BUY CABINET AND SHUGART DRIVES AND SAVE

with power supply and internal data cable

WITH 1 DRIVE		WITH 2 DRIVES	
LBO-801R	$775.00	LBO-801R-2PSC	$1250.00

Drives with cabinet only, no power supply or internal data cable

Shipping Weight, add 15 lbs. per drive

LBO-801R-C	LBO-801R-2C
$539.00	$999.00

EXTERNAL DATA CABLES

CARDEDGE TO CARDEDGE		CARDEDGE TO SOCKET	
PRI-50CE-CE	$19.95	PRI-50CE-SKT	$19.95

SHUGART 801R DISK DRIVE

Double Density Soft or Hard Sector

SHU-801R $499.00

SEND $1.00 FOR 52 PAGE CATALOG

SEND $1.00 FOR 52 PAGE CATALOG

8" DUAL DRIVE SUBSYSTEM

consisting of the following:

CCS 2422	Assembled and Tested DISK CONTROLLER	$ 400.00
CPM 2.2*	Disk Operating System	
LBO-801R-2PSC	2 Shugart 801R Disk Drives in Assembled and Tested Cabinet with Power Supply, Fan, and Internal Data Cable	$1250.00
PRI-50CE-SKT	External Data Cable	$ 19.95
MMM-741-0	3M Scotch Double Density Diskettes (Box of 10)	$ 59.95
MMM-KS10	Diskette Storage Box	$ 4.50
VRB-FD-08	8" Head Cleaning Kit	$ 29.95
	Our Regular Price	$1764.35

SAVE $170.00

SALE PRICED $1595.00

Order Part #CCSLBO1

*CPM is a Registered Trade Mark of Digital Research

auld lang syne

GODBOUT ECONORAM II

WE PURCHASED THEM ALL!

OLD FRIENDS never die — they just go on CLOSE-OUT!!! This is the 8K x 8 static memory that started it all ... plug it into your Altair, IMSAI or other S-100 buss computer, and you've got a memory that just goes on working and working and working. Configured as 2 independent 4K blocks, with separate protect for each block and vector interrupt provision if you try to write into protected memory. Handles DMA devices. All address and data lines fully buffered. Tri-state outputs for use with bi-directional busses. Selectable write strobe (writes on either PWR or MWRITE), and dip switch selectable address. FIRST COME — FIRST SERVE.

GBT-RAMII-UKT 2 lbs. $99.95

CALIFORNIA COMPUTER Z-80 SBC CPU

NEW

- 2 or 4 MHz Operation (selectable)
- Power On Memory Jump
- S-100 Altair/IMSAI Compatible
- Z-80 Monitor Select/Deselect
- Responds to Wait State Generation
- M1 Wait State
- Front Panel Supported
- I/O Address Mirror
- 1-RS232 Serial Port, Selectable I/O Address, with 100% Disable Option





- Factory Assembled and Tested
- Auto Baud Rate Select
- Z-80 Refresh Option
- Z-80 Non Maskable Interrupt Option
- PHANTOM Line Option
- Led's to Indicate: ROM Enable, Halt and Interrupt Enable
- CPU and Baud Rate IC's have separate Crystals

ORDER PART NO.

CCS-2810 $300.00

California Computer Systems

8080 S-100 System Compatibility
Emulates the control, clock, and status signals generated by the 8080. Can emulate 8080 I/O address mirroring. Allows front panel operations. Special Z-80 signals brought onto the bus (REFRESH, NMI, MREQ) made jumper-enabled to avoid possible bus conflicts.

On-board ROM
Comes with programmed 2K EPROM. Jumper-enabled. ROM contains monitor firmware, including driver for on-board serial port. Driver features auto-baud selection which allows serial port to be initialized from the console to any baud rate between 2 and 56000. Optional PHANTOM overlay of ROM.

Board-generated Wait States
Jumper-enabled M1 Wait circuitry increases memory access times by 110 nsecs at 4 MHz and 225 nsecs at 2 MHz. Automatic Wait state inserted when ROM is selected and CPU is operating at 4 MHz.

Operating frequency
2 or 4 MHz, toggle switch selected.

Power Supply
Unregulated +8V, +16V, -16V. Consumes 1 amp at +8V.

Power-on Jump
Forces CPU to jump to any user-selected memory location within 64K when system is turned on or reset.

On-board Serial Port
Conforms to RS-232-C specifications; allows direct plug-in of a cable with a DB-25 female connector. National's 8250 Asynchronous Communications Element allows software-selection of baud rate, serial word length, parity, and number of stop bits. Serial port address is jumper-selected, serial port is also jumper-disabled.

ORDER TOLL FREE 1-800-423-5633 except CA., AK., HI., CALL (213) 894-8171



PRIORITY ONE ELECTRONICS

16723K Roscoe Blvd. Sepulveda, CA 91343

master charge

Terms: Visa, MC, BAC, Check, Money Order, U.S. Funds Only. CA residents add 6% sales tax. Minimum order $10.00 Prepaid U.S. orders less than $75.00 include 5% shipping and handling. MINIMUM $2.50. Excess refunded. Just in case ... please include your phone no. Prices subject to change without notice. We will do our best to maintain prices thru Sept. 1980.
*SOCKET and CONNECTOR prices based on GOLD, not exceeding $500 per oz.

*Sale Prices are for prepaid orders only credit card orders will be charged appropriate freight



FOR MORE INFORMATION SEE OUR 52 PAGE AD in JANUARY BYTE OR SEND $1.00 FOR CATALOG
• Sale Prices are for prepaid orders only • Quantities are limited, subject to prior sale • CREDIT CARD ORDERS WILL BE CHARGED APPROPRIATE FREIGHT

PRIORITY ONE ELECTRONICS

PRIORITY ONE ELECTRONICS



from GODBOUT ELECTRONICS

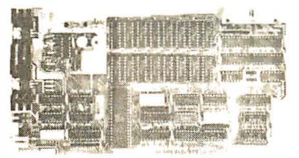
MEET THE ECONORAM FAMILY...........
all ECONORAMS from COMPUKIT include:

- Fully static memory used throughout to promote reliable operation and facilitate direct memory access. (DMA)
- 4 MHz with Z80 - 5 MHz with 8085
- Buffered tri-state outputs and buffered inputs.
- All lines buffered; address and data lines buffered to 1 low power Schottky TTL load, all other lines buffered to less than 1 TTL load.
- Onboard regulation.
- DIP switch address selection and deselection (no wire jumpers).
- Low power Schottky support ICs.
- S-100 boards have WRITE strobe selections switch - allows use of memory with or without front panel.
- All ICs are socketed (including support chips)
- Unique multi-block configurations for addressing flexibility.
- Industry standard board sizes.
- High quality, double sided, plate through, solder-masked and legended circuit board.
- LOW current consumption and guaranteed specs.
- 1 year limited warranty (not just 90 days).

SALE SALE

Most ECONORAMs come in 3 forms; UNKIT (UKT) - (this means that all sockets, disc capacitors are already soldered in place for easy assembly), fully assembled & tested (A&T), or qualified under the Certified System Component (CSC) high-reliability program (200 hour burn-in, guaranteed 4MHz operation over full temperature range, serial numbered, immediate replacement in event of failure with 1 year of invoice date).

NEW SPECTRUM S-100 COLOR GRAPHICS BOARD



Includes 8K of IEEE-compatible static RAM; full duplex bi-directional parallel I/O port for keyboard, joystick, etc. interface; and 6847-based graphics generator that can display all 64 ASCII characters. 10 modes of operation, from alphanumeric/semi-graphics in 8 colors to ultra-dense 256 x 192 full graphics. 75 Ohm RS-170 line output and video output for use with FCC approved modulators. **Introductory prices:**

	Reg.	Sale
GBT-144 KIT	$339.00	$319.00
GBT-144 A (Assembled)	$399.00	$349.00

Don't settle for black and white graphics or stripped-down color boards; specify the CompuPro Spectrum.

Want graphics software? Sublogic's 2D Universal Graphics Interpreter (normally $35) **is yours for $25 with any Spectrum board purchase.**

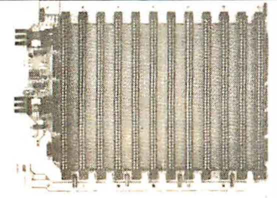
GBT-2D $25.00

NEW! 32K X 8 ECONORAM XX

Static Storage for the S-100 buss

32K BANK SELECT! S-100compatible 5 MHz guaranteed operation (0-70 c). Features 1 x 32K block positionable on any 4K boundry. Windows may be positioned every 4K. Bank Select port may be any one of 256 I/O Ports, and any data bit maybe used as a control bit. Perfect for use on Alpha Micro Systems, Marinchip, Cromemco, and others with IEEE 24 Bit extended addressing. Uses 4K x 1 low power STATIC rams. Current consumption guaranteed 3500 MA max. Shipping Weight 2 lbs.

	Reg.	Sale
GBT-2016 UKT 16K UNKIT	$349.00	$329.00
GBT-2016 AT 16 A&T	$419.00	$369.00
GBT-2024 UKT 24K UNKIT	$479.00	$449.00
GBT-2024 AT 24K A&T	$539.00	$479.00
GBT-2032 UKT 32K UNKIT	$649.00	$598.00
GBT-2032 AT 32K A&T	$729.00	$649.00



SHIELDED/TERMINATED MOTHERBOARDS

A Must for Reliable System Operation!!!

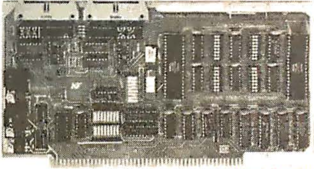
NEW

These are third generation micro-motherboards set up to exceed the latest S-100specs. Designed with operation of the newest 5 to 10 MHz MPUs in mind — with any of these motherboards, you won't have to start from scratch when you want to upgrade your system from 2 or 4 MHz operation.

True active termination — with split termination — half of the termination load at each end of every buss line. Grounded Faraday shield between all buss signal lines to minimize cross-talk. Heavy duty power traces for minimal power loss. Power connectors supplied. All edge connectors & termination resistors supplied soldered to board in "UNKIT" versions. All sizes fit Godbout, Vector, IMSAI, TEI, etc. enclosures.

All boards are double sided fiberglass epoxy, G10/FR4, with plated through holes & solder mask on both sides. A parts legend on the component side makes assembly a snap.

	Reg.	Sale
GBT-CK024 UK 19 SLOT UNKIT	$174.00	$159.00
GBT-CK024 AT 19 SLOT A&T	$214.00	$189.00
GBT-CK025 UK 12 SLOT UNKIT	$129.00	$119.00
GBT-CK025 AT 12 SLOT A&T	$169.00	$149.00
GBT-CK026 UK 6 SLOT UNKIT	$ 89.00	$ 79.95
GBT-CK026 AT 6 SLOT A&T	$129.00	$119.00



CK022 S-100 INTERFACER

Our new I/O board gives you unparalleled flexibility and operating convenience. We include such features as:

- 2 independently addressable serial ports (dip switch selectable addresses)
- Real LSI hardware UARTs for minimum CPU housekeeping
- RS232C, current loop (20mA), & TTL signals on both ports
- Precision, crystal-controlled Baud rates up to 19.2K Baud (individually dip switch selectable)
- Transmit & receive interrupts on both channels, jumperable to any vectored interrupt line
- Industry standard RS232 level converters with five RS232 handshaking lines per port
- Optically isolated current loop with provisions for both on-board & off-board current sources
- UART parameters, inter upt enables & RS232 handshaking lines are software programmable with power-on hardware default to customer specified hard-wired settings for maximum flexibility
- Port connectors mate directly to ribbon cable & DB25 connectors in standard pinouts
- RS232 lines will conform to either master or slave configurations
- Board gives full feature operation with both 2 & 4 MHz systems
- Low power consumption: +8V @ 450mA; +16V @ 150mA; -16V @ 70mA max.
- No software initialization required for board operation, although board parameters may be altered by software 2 lbs.

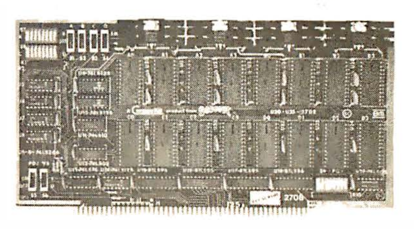
	Reg.	Sale
GBT - INTERFACER I UKT	$199.00	$189.00
GBT - INTERFACER I A&T	$249.00	$219.00

INTERFACER II

The new Interfacer II I/O board incorporates one channel of serial I/O with all the features of the INTERFACER dual RS232 serial board, plus 3 full duplex Parallel ports. The serial section includes all the features you've come to expect - a hardware UART, on-board crystal controlled Buad rate generator, hardware/software programmability, RS232 handshaking lines with real RS232 drivers, current loop & TTL drivers, full interrupts and more!!! The parallel selection utilizes LSTTL octal latches for latched input & output data with 24mA drive current, attention, enable & strobe bits for each parallel port (each with selectable polarity), interrupts for each input port, separate 25 pin connectors with power for each channel and a status port for interrupt mask and port status. All in all - an incredibly flexible and easy to use board.

	Reg.	Sale
GBT - INTERFACER II UKT	$199.00	$189.00
GBT - INTERFACER II A&T	$249.00	$219.00

ECONOROM 2708



Has provisions for wait states for 4MHz operations. Configured as four 4K blocks - each independently addressable and disableable. Power-on jump. Does **NOT** include 2708s. Includes all support chips, sockets, regulators, heat sinks, etc. Sold in UNKIT form **only.** Shipping Weight 2 lbs.

GBT - ECONOROM 2708 UKT $85.00

NEW NEW NEW NEW

	Reg.	Sale
GBT-SPECTRUM (Color graphics) KIT	339.00	319.00
GBT-SPECTRUM (Color graphics) A&T	399.00	349.00
GBT-CPU-Z80 KIT	225.00	210.00
GBT-CPU-Z80 A&T	295.00	269.00
GBT-CPU-8085 KIT	235.00	220.00
GBT-CPU-8085 A&T	325.00	259.00
GBT-CPU-8085/8088 KIT	385.00	365.00
GBT-CPU-8085/8088 A&T	495.00	449.00
GBT-BOX-DESK (S-100 Mainframe)	289.00	269.00
GBT-BOX-RACK (S-100 Mainframe)	329.00	309.00

ECONORAM XIV

16K x 8 for S-100. Addressable on any 4K boundary. Direct addressing on up to 24 address lines. Fully meets IEEE S-100 buss. specs. Low power, hi speed static memory. Operates up to 5MHz with newest 8085/8086/8088 CPUs. Can be used with 8080, Z80, 8085, 8086, 8088, Z8000, etc.

	Reg.	Sale
GBT - ECONORAM XIV UKT	$299.00	$279.00
GBT - ECONORAM XIV A&T	$349.00	$298.00

SEND $1.00 FOR 52 PAGE CATALOG

SEND $1.00 FOR 52 PAGE CATALOG

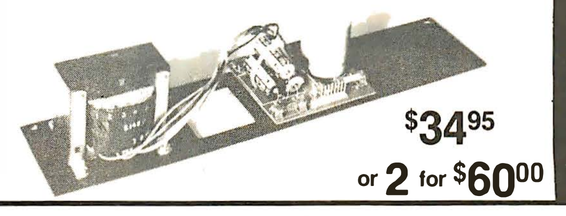
PRIORITY ONE ELECTRONICS

Circle 263 on inquiry card.

PRIORITY ONE ELECTRONICS

S-100 POWER SUPPLY
SPECIAL PURCHASE

Features:
- 8V at 8 Amps
- 16V at 4 Amps
- -16V at 1 Amps
- 110V/220V Adjustable Input
- Industrial Quality
- Fused Outputs
- Conservatively Rated
- Rack Mountable
- Cut Out for Fan
- Manufactured by Alpha Power
- Brand New!
- Documentation Included



Priority 1 Electronics made this special purchase when a large OEM customer defaulted. Take advantage of the Great Opportunity! HURRY, limited quantity. At these prices they won't last long.

$34.95 or 2 for $60.00

TRS-80/APPLE
MEMORY EXPANSION KITS
4116's RAMS

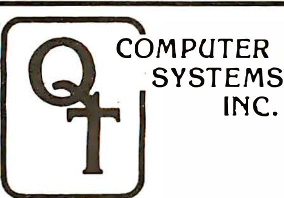
100% GUARANTEED — from Leading Manufacturers — 1,000's SETS SOLD

(16Kx1 200/250ns)

8 for $48.00

ADD $3.00 FOR PROGRAMMING JUMPERS FOR TRS-80 KEYBOARD

4116's 100 pcs & UP $5.20 each
1000 pcs & UP $4.45 each



COMPUTER SYSTEMS INC.

IEEE S-100 COMPATIBLE

Z + 80 CPU

- 1K Ram On Board + 2 Programmable Timers
- Switch Selectable 2 or 4 MHZ
- Power On Jump to On-Board 1K or 2K EPROM (2708-2716-2732) Can be Addressed on any 1K, 2K or 4K Boundary
- Programmable Baud Rate Selection (110 to 9600)
- On-Board EPROM May be Used in Shadow Mode, Allowing Full 64K RAM to be Used
- On-Board USART for Synchronous or Asynchronous RS-232 Operation (On-Board Baud Rate Generator)

Bare Board	$ 45.00	A&T	$229.95
Kit	$169.95	1K Memory Kit	$ 12.00

EXPANDABLE + DYNAMIC MEMORY (16K to 64K)

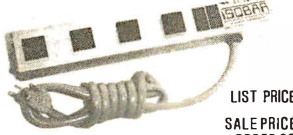
- Works With Cromenco Systems
- Uses 3242 Refresh Chip
- 4 Layers Mean A Quiet Board
- Bank Selectable Write Protect
- Phantom Output Disable
- Switch Selectable Output Disable

Bare Board	$ 49.95	32K Kit	$369.95	48K A&T	$494.95
16K Kit	$295.95	32K A&T	$419.95	64K Kit	$519.95
16K A&T	$345.95	48K Kit	$444.95	64K A&T	$569.95

CLOCK CALENDAR +

- Time of Day in Hours, Minutes and Seconds
- 24 Hour Time Format
- Month and Day Date Function
- Simple Read Instructions Allow Simple Interface to Basic, CPM, Etc.
- Will Run With 4 MHZ Processors
- Can be Located at any Group of 4 I/O Port Addressed

Bare Board $45.00 Kit $99.95 A&T $149.95



LIST PRICE $79.95
SALE PRICE $59.95
ORDER GOF-IBAR46

PROTECT YOUR INVESTMENT
PROTECT YOUR DATA WITH

THE ISOBAR ELECTRICAL OUTLET STRIP CONSISTS OF A MASTER POWER SWITCH, INDICATOR, AND 4 INDIVIDUAL 3 WIRE OUTLETS, EACH WITH ITS OWN NOISE FILTER AND SURGE SUPPRESSOR TO PROTECT YOUR EQUIPMENT FROM DANGEROUS TRANSIENTS FROM OTHER EQUIPMENT PLUGGED INTO YOUR ISOBAR OR FROM WHATEVER THE POWER COMPANY IS DOLING OUT.

WARNING: "Murphy's Law" predicts that after reading this ad and not acting, your equipment will soon be destroyed by a fatal Glitch.



THE STAR MODEM FROM LIVERMORE

0 to 300 baud data rate. Compatible with Bell 103 and 113. Answer/Originate. Full/Half Duplex. Special self test features.

LIST PRICE $199.00
SALE PRICED **$139.00**

ROBINSON NUGENT, INC.

GOLD 3 LEVEL WIRE WRAP SOCKES
SALE
14, 16 & 24 PIN

RNS-14G3	120/$42.00
RNS-16G3	104/$40.00
RNS-24G3	51/$36.00

TI LOW PROFILE SOCKETS

TIS-16 LP	100/$16.00
TIS-14 LP	100/$14.00

3 LEVEL GOLD WIRE WRAP SOCKETS
PRICE*

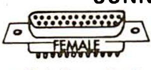
PART NO.	PINS	1-9	10-24	25-99	100-249	250-999
RNS-08WWG	8	.50	.42	.40	.37	.33
RNS-14WWG	14	.60	.49	.47	.45	.42
RNS-16WWG	16	.65	.52	.50	.47	.44
RNS-18WWG	18	.85	.75	.70	.65	.60
RNS-20WWG	20	1.00	.90	.80	.75	.70
RNS-22WWG	22	1.25	1.15	1.10	1.05	1.00
RNS-24WWG	24	1.25	1.15	1.10	1.05	1.00
RNS-28WWG	28	1.60	1.50	1.40	1.30	1.20
RNS-40WWG	40	1.85	1.65	1.55	1.45	1.35

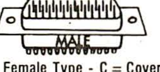
*Price based on gold not exceeding $400.00 per oz.

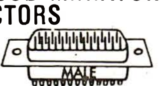
MEMORY HEADQUARTERS

- 2716 16K 5 Volt only EPROM. $16.00 ea. 10/$150.00
- 2708 8K 450ns EPROM .... 8/$55.00 $8.50 ea.
- 2114-3L 1Kx4 300ns Low Power. 8 $45.00 100 + $4.50 ea.
- 5257-3L 4Kx1 300ns Low Power. . 8/$55.00 100 + $5.25 ea.
- 2102AL-2 L/P 250ns in lots of 20. 1.25 ea. 100 + 1.10 ea.

RS232 and "D" SUB-MINIATURE CONNECTORS







P = Plug, Male Type - S = Socket, Female Type - C = Cover, Hood

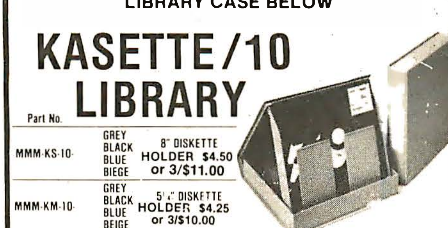
PART NO.	DESCRIPTION	PRICE 1-9	10-24	25-99
CND-DE9P	9 PIN MALE	$ 2.10	$ 1.90	$ 1.70
CND-DE9S	9 PIN FEMALE	$ 2.70	$ 2.40	$ 2.10
CND-DE9C	9 PIN COVER	$ 1.50	$ 1.25	$ 1.10
CND-DA15P	15 PIN MALE	$ 2.75	$ 2.45	$ 2.15
CND-DA15S	15 PIN FEMALE	$ 3.95	$ 3.60	$ 3.20
CND-DA15C	15 PIN COVER	$ 1.50	$ 1.30	$ 1.10
CND-DB25P	25 PIN MALE	$ 3.50	$ 3.25	$ 3.00
CND-DB25S	25 PIN FEMALE	$ 4.60	$ 4.35	$ 4.20
CND-D851212	1 PC. GREY HOOD	$ 1.60	$ 1.45	$ 1.30
CND-P25H	2 PC. GREY HOOD	$ 1.50	$ 1.25	$ 1.10
CND-D851226	2 PC. BLACK HOOD	$ 1.90	$ 1.65	$ 1.45
CND-DC37P	37 PIN MALE	$ 5.80	$ 5.10	$ 4.45
CND-DC37S	37 PIN FEMALE	$ 8.70	$ 7.70	$ 6.70
CND-DC37C	37 PIN COVER	$ 1.80	$ 1.55	$ 1.30
CND-DD50P	50 PIN MALE	$ 8.75	$ 7.75	$ 6.70
CND-DD50S	50 PIN FEMALE	$11.65	$10.25	$ 8.90
CND-DD50C	50 PIN COVER	$ 2.00	$ 1.80	$ 1.60
CND-D20418	HARDWARE SET 2 PR.	$ 1.00	$ 0.80	$ 0.70
CND-RS2328F	RS232, DB25P, EIA CLASS 1 CABLE 8 CON. 8 FT.	$19.95	$17.95	$15.95
CND-5730360	CENT. 700 SERIES PRINTER CONNECTOR	$ 9.00	$ 7.50	$ 6.00

Verbatim

Part No.	Sectoring	Application	Pk. of 2	Box of 10
VRB-MD 525-01	Soft Sector	TRS 80 Apple	$ 8.95	$29.95
VRB-MD 525-10	Hard 10 Sector	North Star	$ 8.95	$29.95
VRB-MD 525-16	Hard 16 Sector	Micropolis	$ 8.95	$29.95
VRB-FD32-1000	Hard Sector	Shugart 801R	$11.95	$37.00
VRB-FD34-1000	Soft Sector	IBM 3740	$11.95	$37.00

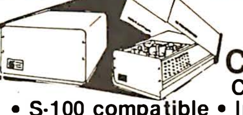
SHIPPING WEIGHT 1 LB

BE SURE TO ORDER YOUR KASSETTE/10 LIBRARY CASE BELOW



KASETTE/10 LIBRARY

Part No.	Colors	
MMM-KS-10	GREY, BLACK, BLUE, BEIGE	8" DISKETTE HOLDER $4.50 or 3/$11.00
MMM-KM-10	GREY, BLACK, BLUE, BEIGE	5¼" DISKETTE HOLDER $4.25 or 3/$10.00



CALIFORNIA Computer Systems

• S-100 compatible • Industrial/commercial quality construction • Flip-top cover • Excellent cooling capability • 12 slot capability (uses model 2501A) • Input 105, 115, or 125 VAC • Output + 8 VDC20A, + −16 VDC 4A • Active termination of all bus lines • Fan and circuit breaker included • Rugged construction

CCS-2200A Assembled & Tested 35 lbs $399.95
CCS-2200AK Kit 35 lbs. $349.95

ORDER TOLL FREE 1-800-423-5633 except CA., AK., HI., CALL (213) 894-8171

VISA

PRIORITY ONE ELECTRONICS
16723K Roscoe Blvd. Sepulveda, CA 91343



Terms: Visa, MC, BAC, Check, Money Order, U.S. Funds Only. CA residents add 6% sales tax. Minimum order $10.00 Prepaid U.S. orders less than $75.00 include 5% shipping and handling. MINIMUM $2.50. Excess refunded. Just in case ... please include your phone no. Prices subject to change without notice. We will do our best to maintain prices thru Sept. 1980.
*SOCKET and CONNECTOR prices based on GOLD, not exceeding $500 per oz.
*Sale Prices are for prepaid orders only credit card orders will be charged appropriate freight

FOR MORE INFORMATION SEE OUR 52 PAGE AD in JANUARY BYTE OR SEND $1.00 FOR CATALOG
• Sale Prices are for prepaid orders only • Quantities are limited, subject to prior sale • CREDIT CARD ORDERS WILL BE CHARGED APPROPRIATE FREIGHT

SEND $1.00 FOR 52 PAGE CATALOG

SEND $1.00 FOR 52 PAGE CATALOG

PRIORITY ONE ELECTRONICS

Circle 263 on inquiry card.

ADVANCED COMPUTER PRODUCTS

7400

SN7400N	.19	SN74123N	.59
SN7401N	.22	SN74125N	.39
SN7402N	.22	SN74126N	.44
SN7403N	.22	SN74128N	.59
SN7404N	.22	SN74132N	.69
SN7405N	.23	SN74136N	.95
SN7406N	.23	SN74139N	.95
SN7407N	.23	SN74141N	.69
SN7408N	.26	SN74142N	2.95
SN7409N	.23	SN74143N	2.95
SN7410N	.22	SN74144N	2.95
SN7411N	.29	SN74145N	.62
SN7412N	.29	SN74147N	1.95
SN7413N	.39	SN74148N	1.20
SN7414N	.59	SN74150N	.99
SN7416N	.29	SN74151N	.67
SN7417N	.29	SN74152N	.67
SN7420N	.22	SN74153N	.67
SN7421N	.35	SN74154N	1.19
SN7422N	.29	SN74155N	.82
SN7423N	.29	SN74156N	.89
SN7425N	.29	SN74157N	.69
SN7426N	.29	SN74158N	1.65
SN7427N	.29	SN74160N	.95
SN7429N	.45	SN74161N	.95
SN7430N	.23	SN74162N	.89
SN7432N	.29	SN74163N	.87
SN7437N	.29	SN74164N	.97
SN7438N	.29	SN74165N	.97
SN7439N	.29	SN74166N	1.20
SN7440N	.24	SN74167N	1.95
SN7441N	.79	SN74170N	1.69
SN7442N	.57	SN74172N	5.95
SN7443N	.79	SN74173N	.79
SN7444N	.79	SN74174N	.89
SN7445N	.79	SN74175N	.89
SN7446N	.79	SN74176N	.85
SN7447N	.59	SN74177N	.85
SN7448N	.79	SN74179N	1.80
SN7450N	.23	SN74180N	.75
SN7451N	.23	SN74181N	1.75
SN7453N	.23	SN74182N	.75
SN7454N	.23	SN74184N	1.95
SN7459N	.29	SN74185N	1.95
SN7460N	.23	SN74186N	9.95
SN7470N	.39	SN74188N	3.90
SN7472N	.34	SN74190N	1.15
SN7473N	.38	SN74191N	1.15
SN7474N	.36	SN74192N	.85
SN7475N	.38	SN74193N	.85
SN7476N	.36	SN74194N	.85
SN7479N	4.60	SN74195N	.85
SN7480N	.59	SN74196N	.85
SN7481N	1.10	SN74197N	.85
SN7482N	1.10	SN74198N	1.39
SN7483N	.55	SN74199N	1.39
SN7485N	.65	SN74221N	1.39
SN7486N	.39	SN74251N	.95
SN7489N	1.75	SN74273N	1.05
SN7490N	.39	SN74279N	.89
SN7491N	.65	SN74283N	2.15
SN7492N	.52	SN74284N	3.90
SN7493N	.49	SN74285N	3.90
SN7494N	.72	SN74290N	1.25
SN7495N	.65	SN74298N	.95
SN7496N	.72	SN74365N	.68
SN7497N	3.10	SN74366N	.68
SN74100N	.99	SN74367N	.79
SN74107N	.32	SN74368N	.79
SN74109N	.53	SN74390N	1.90
SN74116N	1.95	SN74393N	1.90
SN74121N	.29	SN74490N	1.90
SN74122N	.39		

CMOS

CD4000	.29	CD4093	.99
CD4001	.29	CD4094	2.95
CD4002	.29	CD4098	2.49
CD4006	1.39	CD4099	2.25
CD4007	.29	MC14408	12.95
CD4008	1.39	MC14409	12.95
CD4009	.59	MC14410	12.95
CD4010	.59	MC14412	12.95
CD4011	.29	MC14415	8.95
CD4012	.29	MC14419	4.95
CD4013	.49	CD4501	.39
CD4014	1.39	CD4502	1.65
CD4015	1.39	CD4503	.69
CD4016	.59	CD4505	8.95
CD4017	1.19	CD4506	.75
CD4018	1.19	CD4507	.95
CD4019	.49	CD4508	3.95
CD4020	1.19	CD4510	1.39
CD4021	1.49	CD4511	1.39
CD4022	1.29	CD4512	1.39
CD4023	.38	CD4515	3.95
CD4024	.79	CD4516	1.69
CD4025	.38	CD4518	1.39
CD4027	.79	CD4520	1.39
CD4028	.99	CD4555	4.95
CD4029	1.29	CD4556	.99
CD4030	.69	CD4566	2.25
CD4031	3.25	74C00	.39
CD4032	2.15	74C02	.39
CD4034	3.25	74C04	.39
CD4035	1.19	74C08	.49
CD4037	1.95	74C10	.49
CD4040	1.29	74C14	1.65
CD4041	1.25	74C20	.39
CD4042	.99	74C30	.39
CD4043	.99	74C32	.99
CD4044	.99	74C42	1.85
CD4046	2.25	74C48	2.39
CD4047	1.25	74C73	.99
CD4048	.69	74C74	.99
CD4049	.69	74C85	2.49
CD4050	.69	74C89	4.95
CD4051	1.10	74C90	1.85
CD4052	1.10	74C93	1.85
CD4053	1.10	74C95	1.85
CD4055	3.95	74C107	1.19
CD4056	2.95	74C151	2.49
CD4059	9.95	74C154	3.50
CD4060	1.39	74C157	2.10
CD4066	.89	74C160	2.39
CD4069	.35	74C161	2.30
CD4070	.69	74C163	2.39
CD4071	.35	74C164	2.39
CD4072	.35	74C173	2.59
CD4073	.35	74C174	2.75
CD4075	.35	74C175	2.75
CD4076	1.29	74C192	2.39
CD4077	.35	74C193	2.39
CD4076	.35	74C195	2.39
CD4081	.35	74C922	7.95
CD4062	.35	74C923	6.95
CD4085	1.95	MM80C95	1.50
CD4089	2.95	MM80C97	1.25

74LS00

74LS00N	.35	74LS164N	1.19
74LS01N	.28	74LS165N	.89
74LS02N	.28	74LS166N	2.48
74LS03N	.28	74LS168N	1.89
74LS04N	.39	74LS169N	1.89
74LS05N	.28	74LS170N	1.99
74LS08N	.39	74LS173N	.89
74LS09N	.39	74LS174N	.99
74LS10N	.28	74LS175N	.99
74LS11N	.39	74LS181N	2.20
74LS12N	.39	74LS190N	1.15
74LS13N	.47	74LS191N	1.15
74LS14N	1.25	74LS192N	.98
74LS15N	.39	74LS193N	.98
74LS20N	.26	74LS194N	1.15
74LS21N	.38	74LS195N	.95
74LS22N	.38	74LS196N	.89
74LS26N	.39	74LS197N	.89
74LS27N	.39	74LS221N	1.49
74LS28N	.39	74LS240N	2.99
74LS30N	.26	74LS241N	2.49
74LS32N	.39	74LS242N	2.29
74LS37N	.79	74LS243N	2.29
74LS38N	.39	74LS244N	2.95
74LS40N	.26	74LS245N	8.95
74LS42N	.79	74LS247N	1.10
74LS47N	.79	74LS248N	1.10
74LS48N	.79	74LS249N	1.69
74LS51N	.26	74LS251N	1.79
74LS54N	.35	74LS253N	.98
74LS55N	.35	74LS257N	.98
74LS73N	.45	74LS258N	.98
74LS74N	.59	74LS259N	2.95
74LS75N	.68	74LS260N	.69
74LS76N	.45	74LS261N	2.49
74LS78N	.65	74LS266N	.59
74LS83AN	.99	74LS273N	1.75
74LS85N	1.19	74LS275N	4.40
74LS86N	.45	74LS279N	.59
74LS90N	.75	74LS283N	1.10
74LS92N	.75	74LS290N	1.29
74LS93N	.75	74LS293N	1.95
74LS95N	.88	74LS295N	1.10
74LS96N	.98	74LS298N	1.29
74LS107N	.45	74LS324N	1.75
74LS109N	.45	74LS347N	1.95
74LS112N	.49	74LS348N	1.95
74LS113N	.49	74LS352N	1.65
74LS114N	.55	74LS353N	1.65
74LS122N	.55	74LS363N	1.49
74LS123N	1.19	74LS365N	.99
74LS124N	1.35	74LS366N	.99
74LS125N	.89	74LS367N	.99
74LS126N	.89	74LS368N	.99
74LS132N	.79	74LS373N	2.75
74LS136N	.59	74LS374N	2.75
74LS138N	.89	74LS375N	.69
74LS139N	.89	74LS377N	1.95
74LS145N	1.25	74LS385N	1.95
74LS148N	1.49	74LS386N	.65
74LS151N	.79	74LS390N	1.95
74LS153N	.79	74LS393N	1.95
74LS154N	2.49	74LS395N	1.70
74LS155N	1.19	74LS399N	2.95
74LS156N	.99	74LS424N	2.95
74LS157N	.99	74LS668N	1.75
74LS158N	.75	74LS670N	2.29
74LS160N	.98	81LS95N	1.99
74LS161N	1.15	81LS96N	1.99
74LS162N	.98	81LS97N	1.99
74LS163N	.98	81LS98N	1.99

LINEAR

78H05	5.95	LM1414N	1.90
76M06	1.49	LM1458CN/N	.49
78M.G.	1.49	MC1488N	1.49
LM105H	.99	MC1489N	1.49
LM108AH	2.95	LM1496N	.89
LM300H	.79	LM1556N	1.50
LM301CN/H	.35	LM1800N	.79
LM304H	.98	LM1820N	.95
LM305H	.89	LM1850N	.95
LM306H	3.25	LM1889N	3.95
LM307CN/H	.29	LM2111N	1.75
LM308CN/H	.98	LM2900N	.99
LM309K	1.49	LM2901N	2.50
LM310CN	1.25	LM2917N	2.95
LM311D/CN/H	.98	CA3013T	2.29
LM312H	1.75	CA3018T	1.99
LM317T	2.75	CA3021T	3.49
LM318CN/H	1.49	CA3023T	2.99
LM319N/H	1.25	CA3035T	2.75
LM320K-XX*	1.49	CA3039T	1.49
LM320T-XX*	1.25	CA3046T	1.29
LM320H-XX*	1.25	LM3053N	1.49
LM323K	4.95	CA3059N	3.25
LM324N	1.25	CA3060N	3.25
LM339N	.95	CA3062N	4.95
LM340K-XX*	1.49	LM3065N	1.49
LM340T-XX*	1.25	CA3080N	1.29
LM340H-XX*	1.25	CA3081N	1.69
LM344H	1.95	CA3082N	1.69
LM348N	1.85	CA3083N	1.99
LM358CN	.98	CA3086N	1.29
LM360N	1.49	CA3089N	2.75
LM372N	1.95	CA3096N	2.49
LM376N	3.75	CA3097N	1.99
LM377N	3.75	CA3130T	2.49
LM380CN/N	1.25	CA3140T	2.49
LM381N	1.79	CA3146N	2.49
LM383T	1.95	CA3160T	1.49
LM386N	1.49	CA3190N	1.95
LM387N	1.49	CA3401N	.69
LM390N	1.95	MC3423N	1.49
NE531V/T	3.75	MC3460N	3.95
NE555V	.39	SG3524N	3.95
NE556N	.98	CA3600N	3.50
NE561T	19.95	LM3900N	.59
NE562B	7.95	LM3905N	1.49
NE565N/H	1.25	LM3909N	.98
NE566H/V	1.75	RC4131N	2.95
NE567V/H	1.50	RC4136N	1.10
NE592N	2.75	RC4151N	4.50
LM702H	2.99	RC4194	4.95
LM709N/H	.29	RC4195	4.40
LM710N/H	.98	ULN2001	1.25
LM711N/H	.39	ULN2003	1.50
LM715N	1.95	SN75450N	.59
LM723N/H	.75	SN75451N	.49
LM733N/H	.98	SN75452N	.49
LM739N	1.15	SN75453N	.49
LM741CN/H	.33	SN75454N	.49
LM741CN-14	.19	SN75491N	.89
LM747N/H	.79	SN75492N	.89
LM748N/H	.39	SN75493N	.89
LM760CN	2.95	SN75494N	.89
LM1310N	1.90		

BECKMAN Digital Multimeters

MODELS TECH 300 AND TECH 310

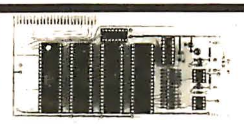


AS LOW AS **$100.00**



Choice of Models – The TECH 310 has all above features, 7 functions, 29 ranges plus 0.25% Vdc accuracy
The TECH 300 has a 0.5% Vdc accuracy and all the above features, but without Insta-Ohms™ continuity function or the 10 amp current ranges.

TECH 300 Digital Multimeter	$100.
TECH 310 Digital Multimeter	$130.
VC-201 Vinyl Carrying Case	$10.
DC-202 Deluxe Carrying Case	$24.
HV-211 High Voltage Probe	$35.
RP-221 RP Probe	$35.
CI-231 AC Current Clamp	$42.
DL-241 Deluxe TestLead Kit	$10.
TL-242 Spare Test Leads (6 pcs.)	$6.



Vista™ MUSIC MACHINE 9©

WITH 9 VOICES!

- NEW! Uses latest State of the Art LSI Technology
- Requires only one slot for 9 voices
- Uses three AY3-8910's to produce nine voices (Other competitive models have only 3 voices)
- Includes software
- Simulates three ALF Boards
- Plays music generated by the ALF Board
- APPLE™ II compatible
- ALF software required

3 Times More Powerful Than ALF!

KIT	$199.95
ASSEMBLED AND TESTED	$269.95

THE BONE FONE

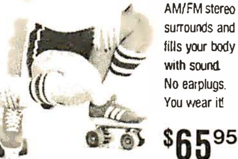
- SKIERS
- JOGGERS
- SKATERS
- CYCLERS



You must hear it and feel it to believe it!

AM/FM stereo surrounds and fills your body with sound.

No earplugs. You wear it!



$65.95

FLOPPY DISK DRIVES

MPI B51-5¼", 40 tracks	279.00
Shugart SA400-5¼" 35 tracks	295.00
Shugart 800/801R 8"	475.00
Siemens Shugart Compatible Model FDD-120-8D	429.00
PERSCI Model 277 Dual	1195.00
WANGO/SIEMENS 5¼" Drive	290.00
MPI B52 5¼" Dual	395.00
WANGO/SIEMENS 282 Dual 5¼"	395.00
WANGO/SIEMENS 82	290.00

MONITORS

Sanyo 9"	$169.95
Sanyo 15"	279.00
Leedex 12"	139.95
Motorola 12", High Resolution, 22 MHz, OEM Model # M3000-340	219.00
Zenith 13" Color Monitor	499.00
MGA 13" Color TV	349.00
VAMP 19" Color Monitor	575.00
VAMP 15" Color Monitor	449.00

CSC CONTINENTAL SPECIALTIES

Model 3001 Digital Capacitance Meter	275.00
Model 333 Tri-Mode Comparator	295.00
Model LM-3 40-channel Logic Monitor	58500
Model LM-1 Logic Monitor	60.00
Model LM-2 Logic Monitor	147.00
Model 2001 Sweepable Function Generator	186.00
Model 5001 Universal Counter-Timer	360.00
Model 6001 650 MHz Frequency Counter	385.00
MAX-100 100 MHz Portable Frequency Counter	149.00
PS-500 500 MHz Decade Prescaler	70.00
MAX-50 50 MHz Handheld Frequency Counter	77.00
MAX-550 550 MHz Handheld Frequency Counter	165.00
Model 4001 Pulse Generator	835.00
Model DP-1 Digital Pulser	83.00
Logic Probes	
Model LP-1 Digital Logic Probe	50.00
Model LP-2 Economy Logic Probe	28.00
Model LP-3 High Speed Logic Probe	77.00
Model LPK-1 Logic Probe Kit	21.95
Logic Probe Accessories	21
Model LTC-1, LTC-2 Logical Analysis Kits	220/250

Apple II. 16K or Apple II. Plus $990

DISK SYSTEM SPECIAL

Apple II Plus w/48K Supermod Video Modulator
Disk II w/Controller Integer Based ROM Card.
Reg. $2,220.00, ACP Price $1819.00 SAVE $401.00

Hi-Speed Serial I/O	$18900	DS65 Digi-Sector	$349.00	Integer ROM Card	$18900
Centronics Printer I/O	199.95	Apple Graphics Tablet	72500	Proto Card	21.95
Applesoft II Firmware	18900	D.C. Hayes Modem II	349.95	M & R Modulator	2995
Apple Clock	269.00	Disk II w/Controller	559.00	Sanyo Cassette	54.95
Introl X-10 System	26995	Disk II	459.00	16K Upgrade Kit	6295
Introl X-10 Controller	179.95	Pascal Lang System	45000	Desktop Plan	9800
Alf Music Synthesizer	25995	Parallel Printer Card	165.00	8" Floppy Controller	35000
16 Ch. Analog Input	24995	Communications Card	189.00	Heuristics Speechlab	17900
2 Ch. Analog Output	164.95	BusinessSoftwarePkg	625.00	Romptus +	16900
13-Key Keypad	11995	Corvus 10 Megabyte Drive	4625.00	Supertalker	27900
Visi-Calc	12500			Cashier	250.00

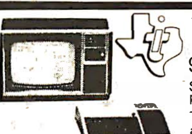
ATARI® 800 & 400

Personal Computer System

ATARI 800 $825.00
ATARI 400 $449.00

ATARI 800 Includes: Computer Console, BASIC Lang. Cartridge, Education System Master Cartridge, BASIC Language Programming Manual, 800 Operator's Manual w/Notebook, Atari 410 Program Recorder, 16K RAM Module, Power Supply, TV Switch Box.

Peripherals		**Education System Cassette Programs**		Spelling	3500
Disc Drive	59900	U.S. History	35.00	Basic Electricity	3500
Printer	49900	U.S. Government	3500	Basic Algebra	3500
Program Recorder	6900	Supervisory Skills	3500	**Basic Game and Program Cassettes**	
Software – ROM Cartridges		World History (Western)	3500	Guide to BASIC Programming	18.00
Education System Master Cartridge	2800	Basic Sociology	3500	BASIC Game Programs	19.00
Atari BASIC	5500	Counseling Procedures	3500	**Add-On Memory**	
Assembler Debug	5500	Principles of Accounting	3500	8K RAM Memory Module	110.00
Basketball	42.00	Physics	3500	16K RAM Memory Module	22500
Life	42.00	Great Classics (English)	35.00	**Diskettes**	
Super Breakout™	4200	Business Communications	35.00	Blank Diskettes	
Music Composer	5500	Basic Psychology	3500	Disk File Manager	5.00
Super Bug™	4200	Effective Writing	3500	**Accessory Controllers**	
Computer Chess	5500	Auto Mechanics	35.00	Driving Controller Pair	1800
Home Finance	5500	Principles of Economics	3500	Paddle Controller Pair	18.00
				Joystick Controller Pair	18.00



TEXAS INSTRUMENTS INCORPORATED

99/4 PERSONAL COMPUTER

Superior Color, Music, Sound and Graphics – and a Powerful Extended Basic – All Built In.

TI 99/4 Console only available for $659.00 **$1099.00**

commodore PET AS LOW AS $775.00



DISCOUNT PRICES

2001-8K	775.00	202380-Col Plain Paper Printer	69500
2001-16KN	97500	2040 Dual Mini Disk Drive	125000
2001-16KB (reg)	975.00	Pet to IEEE Cable	3995
2001-32KN	125000	IEEE to IEEE Cable	4995
2001-32KB (reg)	125000	C2N External Cassette Deck	9500
2022 80-Col Dot Matrix Printer	79500		

CompuCruise — Zemco, Inc.



Model 44 with cruise control **$174.95**

Model 41 without cruise control **$154.95**

An onboard navigational computer for automobiles, trucks, and recreational vehicles. Features cruise control, fuel management system, trip computer, multifunctioned quartz crystal time counter, plus many other functions.

BACK TO SCHOOL SPECIALS

Texas Instruments

Speak & Spell	$59.95
Speak & Spell Modules	15.95
Spelling Bee	32.95
Dataman	21.95
Little Professor	13.95
Mr. Challenger	33.95
30SP Student Math Kit	18.95

Coleco

Quiz Wiz	$25.95
Quiz Wiz Cartridges	5.99

Mattel

Brain Baffler	$45.95

HOME BURGLAR ALARM

GE GUARDIAN ELECTRONICS, INC.



ACP PRICE ONLY **$189.00**

- No installation
- Protects a whole house
- Turns on lights automatically
- Powerful electric siren
- Exit and entry delay
- Battery back-up

The thermostat that uses microprocessor technology to save fuel and money.

PROGRAMMABLE TEMPERATURE CONTROLLER



ACP PRICE **$69.95**

A fully automatic electronic thermostat. Easy to install and operate. Compare the cost: TPI's temperature controller is the lowest priced electronic thermostat on the market.

SINGLE BOARD COMPUTER SELECTION GUIDE

BOARD	PROCESSOR	ACP PRICE	ENCLOSURE
KIM-1	6502	169.00	Add 29.95
SYM-1	6502	239.00	Add 39.95
Cromemco	Z80	409.00	N/A
SD-SBC100	Z80	239.00	N/A
AIM 65	6502	375.00	Add 49.95
Cosmac Vip	1802	199.00	Inc.

RETAIL STORES OPEN MON-SAT

STORE #1 — 1310 "B" E. Edinger, Santa Ana, CA 92705 — Showrooms, Retail, Warehouse

STORE #2 — 674 El Camino Real, Tustin, CA 92680 — Specializing in Systems

P.O. Box 17329 Irvine, Calif. 92713
Direct Order Lines: (714) 558-8813
(800) 854-8230 or (800) 854-8241

FOR INTERNATIONAL ORDERS:
1401 E. Borchard (714) 953-0604
Santa Ana, CA 92705 TWX: 910-595-1565

Circle 264 on inquiry card.

ADVANCED COMPUTER PRODUCTS

GET YOUR 1980 CATALOG

FIRST TO OFFER PRIME PRODUCTS TO THE HOBBYIST AT FAIR PRICES!

1. Proven Quality Factory tested products only.
2. Guaranteed Satisfaction
3. Over $1,000,000.00 Inventory

1980 CATALOG NOW AVAILABLE.

Send $2.00 for your copy of the most complete catalog of computer products.
A must for the serious computer user.

STATIC RAM BOARDS

Now less than 1/2¢ per bit!

• S-100 32K (uses 2114)

ASSEMBLED		Kit	
450ns.	499.00	450ns.	469.00
250ns.	539.00	250ns.	499.00

Bare Board 49.95
Bare Board w/all parts less mem. 99.95

• S-100 16K (S-100 Compatible)
• Low Power
• 2 MHz or 4 MHz
• Assembled & Tested
WOW!
2 MHz $250.00
4 MHz $265.00

• LOGOS I 8K

ASSEMBLED		KIT	
450 ns.	149.95	450ns.	125.95
250ns.	169.95	250ns.	149.95

Bare PC Board w/Data $21.95
"Special Offer" Buy (4) 8K 450ns. Kits $117.00

The VISTA V-80 Disk Drive System

• 23% more storage capacity than TRS-80
• 120 day warranty
• 40 track patch at NO CHARGE

Single drive system	$ 395.00
Two drive system	$ 770.00
Four drive system	$1450.00
Two drive cable	$ 29.95
Four drive cable	$ 39.95

THE VISTA V-200 FOR EXIDY

Price: Starting as low as $1199.00

Item	Storage Capacity	Drive Configuration	Shipping Weight	Price
V200 E-20	400	2 Drive, Single Head	25 lbs	1199.00
V200 E-22	800	2 Drive, Double Head	25 lbs	15-19.00
V200 E-30	600	3 Drive, Single Head	32lbs	1524.00
V200 E-32	1.2 MEG	3 Drive, Double Head	32lbs	1999.00

ATTENTION VIDEO HOBBYISTS!!!

★ BOX BUILDERS
★ USE AS REMOTE TUNER/TIMER
★ FULL SCHEMATICS AVAILABLE
★ FOR ONLY $5.90! – FREE W/PURCHASE

A Recent Special Purchase Allows Us To Present The Following:

NEW, UNUSED COMPONENTS From The RCA VDT-201 Videocassette Recorder

1. UHF/VHF Tuner Subassembly with all knobs and Video Demodulator $59.95
2. RF Modulator with Audio & Video inputs Channel 3 or 4 Output $39.95
3. Digital Clock Module AM/PM Fluorescent Readout (Green) $19.95
4. 300 Ohm to 75 Ohm Matching .... $ 2.49
or — Subtotal $123.34
5. Complete Set of All The Above for Only $74.95

Please Call For Volume Discounts



LOW COST FLOPPY DISK SUBSYSTEM

Shugart 801R Drives (2) VISTA Floppy Controller (S-100), Case, Power Supply & Cable. CP/M Disk Operating System Assembled & Tested $1499.00
★CHECK OUR FLOPPY DISK PRICING! ON THIS PAGE
SAVE $300.00 ($1799.00 Value)

WATANABE MIPLOT



Max pen speed 50 mm/sec, resolution 10 mm typically 05 mm built-in character generator sizes and 4 degrees of rotation absolute draw, relative draw, alpha printing done with simple commands **$1195.00**

IMS STATIC RAM BOARDS

	250 ns.	450 ns.
8K Static	$209.00	$189.00
16K Static	$449.00	$399.00
32K Static	$729.00	$629.00

ANADEX PRINTER NEW APPLE VERSION



Model DP-8000 compact, impact, parallel or serial. Sprocket feed, 80 cols, 84 lines/min., bi-directional.
New only $875.00
DP-8000AP (for Apple) $875.00

SALE! SD SYSTEMS BOARDS
TAKE 10% OFF!

	KIT	ASSEM
SBC 100 Single Board Computer (2MHz)	$265.00	$ 349.00
SBC 200 Single Board Computer (4MHz)	299.00	399.00
Z80 Starter System	319.00	449.00
VDB 8024 Video Display Board	335.00	459.00
Versa-Floppy II	325.00	429.00
Expando PROM	115.00	225.00
SD100 Computer System w/64K	-	6995.00
SD200 Computer System w/64K	-	7995.00

6800 MICROMODULE™ PRICE LIST

MODEL NO	DESCRIPTION	PRICE
9600A	Single Board Microcomputer	$495.00
9609	Advanced Single Bd. Comp. (6809)	595.00
9601	16 Slot Mother Board	175.00
9602	Card Cage	75.00
9603	8 Slot Mother Board	100.00
9604	Power Supply	275.00
9605	DC Input Power Supply	325.00
9610	Utility Proto Board	39.00
9611	Arith. Proc/Memory Module	495.00
9612	Buffered Utility Proto Board	49.00
9616	32K EPROM/RAM Module	250.00
9617	EPROM Programming Head	250.00
9620	16 Channel Parallel I/O Module	295.00
9622	Serial-Parallel I/O Module	325.00
9627	16K Static RAM Module 470ns	395.00
9629	32K Static RAM 450ns	695.00
9629A	32K Static RAM 200ns	895.00
9630	Card Extender	68.00
9640	Multiple Programmable Timer	395.00
9650	8 Channel Duplex Serial I/O Mod.	395.00
9655	Intelligent Tape Controller	550.00
96103	32/32 I/O Module	275.00
96702	Contact Closure Module	350.00

UNPOPULATED BOARDS (Also Available)

APPLE/EXIDY/EXPANDO TRS 80 16K-UPGRADE KIT

$54.95 TRS-80/APPLE $54.95

MEMORY EXPANSION KITS, 4116's, 16K (200/250 ns.)
8 pcs for $54.95
w/instructions & jumpers
Call For Volume Pricing

★ Special: TRS80 Schematic .... $ 4.95
★ Expansion Interface Schematic .. $ 4.95
★ Expansion Interface Connector ... 7.95

EXPANDORAM II MEMORY KITS

★ Bank Selectable ★ Uses 4116 200 ns.
★ Write Protect ★ Power 8VDC, ±16VDC
★ Phantom ★ Up to 4 MHz
NEW LOW PRICES
Expando 64 Kit (4116) Assem. & Tested Add $50.

16K	$269.00	48K	$435.00
32K	$349.00	64K	$505.00

HAZELTINE TERMINALS
SALE $749.00

Model 1400	$749.00	Model 1500	$1085.00
Model 1410	$825.00	Model 1510	$1245.00
Model 1420	$945.00	Model 1520	$1495.00

UV "Eprom" Eraser

Model UVs-11E $69.95
Holds 4 Eprom's at a time.
Backed by 45 years experience.
Model S-52T...$265.00
Professional Industrial Model

EMAKO-20.. Reg. $777.00 $599.00



UNBELIEVABLE!!
125 Caps, 60lpm - Vertical Formal Unit - 96 Characters - Upper/Lower Case - 4.5" to 9.5" Adjustable - 80 col/40 col double width - Full 96 char. ASCII

EMAKO-22............$799.00

Prints a 132 col/line. Available with parallel or serial output at same price.

MIKA 20..............$1280.00

9x7, 125 cps 136 characters/line
Full 15" width. Super for business applications requiring large IBM format paper.

BASE II PRINTER

80 Column Impact Printer
• 60 Lines Per Minute
• 115/230VAC.50 or 60 Hz.
• 72, 60, 96, 120 or 132 Char/Line
• Self-Test Switch

REG. $649.00
ACP PRICE **$550.00**

Option "M" Terminal Screen Buffer (1920 Char.) $50.00
Option "S" High Speed Paper Advance & Graphics 50.00
Option "T" Tractor Feed 50.00

Z-80/Z-80A/8080 CPU BOARD

★ On board 2708 ★ 2708 included (450ns.)
• Power on jump ★ completely socketed
• Z-80 Assembled and Tested $185.00
• Z-80 Kit $129.95
• Z-80 Bare PC Board .... $ 34.95
★ For 4MHz Speed Add $15.00
8080A Kit .... $ 99.95
8080A Assembled $149.95

S-100 MOTHERBOARD SPECIAL

8 slot expandable w/9 conn.
reg $69.95 .... NOW $52.95

SIEMEN'S FLOPPY

• Special buy while supply lasts.
• 8" Drive with Double-Density
• 90 Day Warranty

★CHECK OUR FLOPPY DISK PRICING! ON THIS PAGE

SALE
SIEMENS $429.00
SHUGART 801R $475.00

ACOUSTIC MODEM

NOVATION CAT™
0-300 Baud
Bell 103
Answer, Originate $169.95

DATA BOOKS • COMPUTER BOOKS

1980 IC Master	59.95	Intel MCS 80 Manual	7.95
NSC TTL Data	3.95	Intel MCS 40 Manual	4.95
NSC Linear	4.95	AMD 6060A Manual	5.95
NSC Linear App Notes II	3.95	AMD Schottky Databook	4.95
NSC CMOS	3.95	AMI MOS/LSI Data	3.95
NSC Memory	3.95	GI MOS/LSI Data	4.95
Intel Databook	7.50	Harris Analog Databook	4.95
Intel MCS 85 Manual	7.50	TI Linear Control Data	3.95

SALE • OSBORNE BOOKS • SALE

	Reg.	Sale
Intro to Micros Vol. 0	~~8.50~~	7.75
Intro to Micros Vol. I	~~8.50~~	7.75
8080A Programming	~~8.50~~	7.75
6800 Programming	~~8.50~~	7.75
Z80 Programming	~~8.50~~	7.75
Vol. II Some Real Microprocessors w/Binder	~~30.00~~	27.50
Vol. III Some Real Support Devices w/Binder	~~20.00~~	18.50
Intro to Micros Vol. III	~~20.00~~	18.50

SALE • SYBEX COMPUTER BOOKS • SALE

6502 Games	$12.95
Intro. to Personal & Business Computing	12.95
Mircoprocessors From Chips to Systems	12.95
Microprocessor Interfacing Techniques	12.95
Programming the Z80	12.95
Programming the Z8000	12.95
Programming the 6502	12.95
6502 Applications Book	12.95

MICROPROCESSORS

Z6001 16 bit to 8Mb.	$189.00
Z8002 16 bit to 64K	149.00
Z 80	10.75
Z80A	14.50
F-8(3850)	16.95
2650	18.95
CD1802	13.95
8060A	8.50
8080A-4MHz	19.95
SALE 8085	19.95
8008-1	14.95
2901	9.90
2901A	14.95
2903 4-bit Superslice	29.95
TMS 9900JL	49.95
CP1600	39.95
6502	11.50
6502A	16.95
IM6100	29.95
6800	11.75
6800B 2.0 MHz	19.95
6802P	17.95
8035	19.95
8755	49.95
8748	69.95
6809	64.95
8086	69.95

ADVANCED SUPPORT

AM9511 Arith. Processor	175.00
9512 Arith Processor	175.00
9513 Univ. Timing	79.95
AM9517 DMA Controller	16.95
AM9519 Universal Interrupt	18.95

Z-80 SUPPORT CHIPS

Z80-PIO	2.5 MHz	8.75
Z80A-PIO	4.0 MHz	12.95
Z80-CTC	2.5 MHz	8.75
Z80A-CTC	4.0 MHz	12.95
Z80-DMA	2.5 MHz	29.95
Z80A-DMA	4.0 MHz	36.95
Z80-SIO/0	2.5 MHz	35.95
Z80A-SIO/0	4.0 MHZ	39.40
Z80-SIO/1	2.5 MHz	35.95
Z80A-SIO/1	4.0 MHz	39.40
Z80-SIO/2	2.5 MHz	35.95
Z80-SIO/2	4.0 MHz	39.40

8080/8085 SUPPORT

8155/8156 I/O	24.95
8755 I/O with Eprom	64.95
8202 Dyn. Ram Cont.	34.95
8205/74S 138 Decoder	3.95
8212 8 bit I/o	2.75
8214 Priority Int.	5.25
8216 Bus Driver	2.75
8224 Clock Gen.	2.95
8224-4 (4MHz)	9.75
8226 Bus Driver	3.95
8T26 Bus Driver	2.95
8228 Sys. Control	5.50
8238 Sys. Cont.	5.50
8251 Prog. I/O	6.95
8253 Int. Timer	16.95
8255 Prog. I/O	6.50
8257 Prog. DMA	16.95
8259 Prog. Intl.	17.95
8275 CRT Controller	59.95
8279 Prog. Keyboard	18.95

6800 SUPPORT CHIPS

6810 126 x 8 Ram	4.75
6820 PIA	5.95
6821 PIA	6.50
6628 Priority Int.	9.95
6834-1 512 x 8 Eprom	16.95
6845/HD46505 CRT Cont.	39.95
6847 Color CRT	49.95
6850 ACIA	5.95
6852 Serial Adapter	5.95
6860 Modem	10.95
6862 Modulator	11.95
6871A 1.0MHz OSC.	25.95
6875	8.25
6880 Bus Driver	2.95
MC66466	19.95
68047	24.95

1802 SUPPORT CHIPS

1821 SCD 2K RAM	25.00
1822 SCD 256 x 4 RAM	16.95
1824 CD 32 x 8 RAM	9.95
1852 CD 8 bit I/o	10.95
1854 Uart	10.95
1856 CD I/O	8.95
1857 CD I/O	8.95
1861	12.95

6502 SUPPORT CHIPS

6520 PIA	7.50
6522 Mult.	11.95
6530-002,003,004,005	21.95
6532	19.95
6551	19.95

PROMS

2708 450 ns.	8.25
2708-6650 ns.	7.50
1702A	4.95
2732	74.95
2716-5V	29.95
2716-5V, 12V	29.95
2758-5V	29.95
5203AO	13.95
5204AO	14.95
IM 5610	3.90
SALE 8223 32 x 8	2.95
82S115 512 x 8 (TS)	16.95
82S123 32 x 8	4.90
82S126 256 x 4	4.90
82S129 256 x 4 (TS)	4.90
82S130 512 x 4 (OC)	6.50
82S23	6.95
82S131	14.95
82S137	14.95

NOTE: WE PROGRAM PROMS

CHARACTER GEN.

2513-001 (5V)Upper	9.50
2513-005 (5V)Lower	10.95
2513-ADM3 (5V) Lower	14.95
MCM6571	11.75
MCM6571A	11.75
MCM6574	14.50
MCM6575	14.50

UARTS/BAUD RATE

TR1602B (5V 12V)	3.95
AY51013 (5V, 12V)	4.95
AY51014A/1612 (5-1.1V)	6.95
AY51015A/1863 (5V)	6.95
TMS 6011 (5V 12V)	5.50
IM6402	7.95
IM6403	8.95
2350 USRT	9.95
1671B Astros	24.95
SALE TR1472B	9.95
MC14411	11.95
4702	14.95
WD1941	9.95
COM 5016	16.95

KEYBOARD ENCODERS

AY5-2376	13.75
AY5-3600	13.75
HD0165	9.95
74C922	9.95
74C923	9.95

STATIC RAMS

	1-24	25-99	100
21L02 450ns.	1.30	1.25	99
21L02 250ns.	1.59	1.55	1.15
2111	3.75	3.65	3.55
2112-1	2.95	2.85	2.65
2101-1	2.90	2.70	2.55
2114L-250ns. (4045)	8.95	7.50	6.50
2114L-450ns. (4045)	5.50	5.25	4.75
4044 250 ns.	8.95	7.50	6.90
4044 450ns.	5.95	5.95	4.75
EMM4200A	9.75	8.75	7.95
EMM4402	7.95	7.25	6.25
74589	2.95	2.50	2.25
5101C-E	7.95	7.95	7.25
AMD9140/41	10.95	10.25	9.25
AMD9130/31	12.95	11.95	10.25
1101	1.95	1.75	1.25
P2125/93425 (45ns.)	9.95	8.35	8.25
6508 1K x 1 CMOS	7.95	7.95	7.25
6518 1K x 1 CMOS	7.95	7.95	7.25
74S189 64 bit Ram	3.95	3.25	2.50
2147 LowPower 4K Static	19.95	18.95	16.95

DYNAMIC RAMS

416/4116 16K (16 Pin)	8.75
Set of 8 416's	54.95
4115 8K (16 Pin)	6.95
4050 4K x 1 (18 Pin)	4.95
4060 4K x 1 (22 Pin)	4.95
4096 4K x 1 (16 Pin)	3.95
2104 4K x 1 (16 Pin)	4.75
4027 4K x 1 (16 Pin)	4.95

5261	1.95	1103	1.95
5262	1.95	4008L	4.95
5270	4.95	6605	7.95
5280	4.95	6604	4.95
5290	12.45	6002	1.50

64K RAMS $175.00

SOCKETS

# Pins	Lo-Pro Soldertail	Wire Wrap 3 Level Tin	Gold
8	.15	.32	.45
14	.19	.36	.59
16	.20	.38	.62
18	.24	.59	.84
20	.29	.69	.99
22	.24	.79	1.10
24	.38	.85	1.20
28	.43	1.10	1.49
36	.58	1.25	1.69
40	.60	1.40	1.89

ZERO INSERTION FORCE

16 Pin $5.50 24 Pin $7.50 40 Pin $10.25

LED READOUTS

Part No.	Size	Color	Description	Price
DL704	300	Red	Comm Cathode	99
DL707	300	Red	Comm Anode	99
FND357	.357	Red	Comm Cathode	99
FND501	500	Red	Comm Cathode (+1)	99
FND503(500)	500	Red	Comm Cathode	99
FND507(510)	500	Red	Comm Anode	99
FND508	500	Red	Comm Anode (+1)	99
FND530	500	Green	Comm Cathode	149
FND550	500	Orange	Comm Cathode	149
FN 803(800)	800	Red	Comm Cathode	175
FND807(810)	800	Red	Comm Anode	175
HP5082-7340	600	Red	4 x 7 Hexidecimal	2095
HP5082-7300	600	Red	4 x 7 Sgl Digit RHD	1895
HP5082-7731	.300	Red	Comm Anode	75
TIL305	-	Red	Array 5 x 7	795
TIL308	270	Red	Numerical Display	1095
TIL309	270	Red	Numerical Display	995
TIL311	270	Red	4 x7 Hexidecimal	1095
MAN2A	320	Red	Array	595
MAN10A	270	Red	Alpha Numeric	895
XAN3061	300	Red	Comm Anode Right DP	125
XAN3062	300	Red	Comm Anode Left DP	125
XAN3063	300	Red	Overflow, CA Left DP	125
XAN3064	300	Red	Comm Cathode Right DP	125
XAN3051	300	Green	Comm Anode Right DP	199
XAN3052	300	Green	Comm Anode Left DP	199
XAN3053	300	Green	Overflow CA Left DP	199
XAN3054	300	Green	Comm Cathode Right DP	199
XAN3081	300	Yellow	Comm Anode, Right DP	210
XAN3082	300	Yellow	Comm Anode, Left DP	210
XAN3083	300	Yellow	Overflow CA Left DP	210
XAN3084	300	Yellow	Comm Cathode, Right DP	210

IC SPECIAL PURCHASE

LF 13508 JFET Analog Multi 8 bit	8.95
ICM 7045 Precision StopWatch	23.95
ICM 7205 CMOS LED Stopwatch/Timer	19.95
ICM 7207 Oscillator Controller	7.50
ICM 7208 Seven Decade Counter	18.95
ICM 7209 Clock Generator	6.95
ICL7107 3½ Digit A/D (LED)	14.95
MC14433P 3½ Digit A/D Converter	13.95
ICL 8211 Voltage Reference	1.95
LM 390N Battery Op. Audio Amp	3/1.00
LM 1800N PLL FM Stereo	3/1.00
LM 1820N AM Radio	3/1.00
LM 1850N Ground Fault IC	3/1.00
LM 2900N Quad Amplifier	2/1.00
LM 2901N (HM) Quad Comparator	2/1.00
LM 2917N Freq. to Volt Conv	2/1.99
AY-3-3550 4½ digit DMM	24.95
AY-5-3507 40MHz DVM	9.95
MEM 4963 Mosfet Smoke Detector	11.95
27S08 32 x 8 Prom (IM 5600)	2.95
G115M 6 channel Mosfet	1.49
ULN 2003A 7 channel Driver	.99
2101AL-4	1.95
MCM 14505 64 bit Static Ram	6.95

7520/25	50	LM 377	1.25
1488/1489	2/1.99	LM 387	1.25
MK5014 Calc	3/1.99	LM 3302	3/1.99
74S89	3/1.99	LM 4558	3/1.99
78H05K	6.95	RC 4136	2/1.99
LM323K	4.95	RC 4131	2/1.99
MC1372	8.95	COM 5027	39.95
MM5298-4A/B	2.95	COM 5037	49.95

VERBATIM DISKETTES
100% CERTIFIED ERROR-FREE!

• 35 TRACKS. DOUBLE DENSITY SINGLE-SIDED 5¼

TYPE	DESCRIPTION	PRICE BOX 10
525-01	Soft Sectored TRS 80 etc	$27.25
525-10	10 Hole Hard NS Apple etc	27.25
525-16	16 Hole Hard Micropolis	27.25

• 40 & 77 TRACK DOUBLE DENSITY – SINGLE SIDED 5¼ W/HUB REINFORCEMENT RING

577-01	Soft Sectored TRS 80 etc	$32.25
577-10	10 Hole Hard NS Apple etc	32.25
577-16	16 Hole Hard Micropolis	32.25

• 40 TRACKS. DOUBLE SIDED. DOUBLE DENSITY 5¼

550-01	Soft Sectored S.A 450 MPI 52	$39.50
550-10	10 Hole Hard BASF WANGCO	39.50
550-16	16 Hole Hard Micro?	39.50

• 8" 100% CERTIFIED DISKETTES

FD800 01	Soft Single Density 3740	$33.50
FD800 32	32 Hard Single Density Shug	33.50
FD802-01	Soft Double Density 3740	44.80
FD850-01	Soft Double Sided Double Density 3740	49.80

VOLUME DEALER PRICING AVAILABLE
WE ALSO STOCK DYSAN-CALL

FLOPPY DISK I/O

1771-01 8"& Minifloppy	24.95
uPd372 Nec Floppy	49.95
1781 Dual Floppy	29.95
1791-01 Dual Floppy	36.95
uPd 765 Floppy	49.95

A/D CONVERTERS

8700 8 bit Binary	13.50
8701 10 bit Binary	22.00
8703 8 bit TS	13.50
9400 Volt to Freq. Conv.	7.25
8750 3½ Digit BCD	13.95
1408L6 6 bit	3.95
1408L8 8 bit	5.95
DAC01 D to A	5.95
DAC08	9.95

TV CHIPS/SOUND

AY38500-1 6 Games B/W	4.95
AY38515 Color Converter	2.95
AY38603-1 Roadrace Game	8.95
AY38605-1 Warfare Game	CALL
AY38606-1 Wipeout Game	9.50
AY38607-1 Shooting Gallery	8.95
AY38910 Sound Generator	12.95
SN76477 TI Sound Generator	3.95
MM5320/21 TV Synch Gen.	9.95
MM5369 Prescaler	3.95
LM1689 RF Modulator	3.95
MM57100NSC ColorTV	6.95
MM57104 Clock Gen.	3.75
RF Modulator w/Audio	6.95
M&R Modulator	29.95

WAVEFORM GEN.

8038 Function Gen.	3.95
MC4024VCO	2.95
LM566VCO	1.95
XR2206 Function Generator	5.25

SHIFT REGISTERS

MM500H Dual25	.50
MM5056N Dual 256	2.95
MM5060N Dual 126	2.95
2510A Dual 100	1.95
2647 Quad80	4.95
3341 Dual 80	4.95
3351 40 x 9 FIFO	17.95
3357 Quad80	6.95
9403 16 x 4 FIFO	24.95
9408 10 Bit Sequencer	9.95

CTS DIPSWITCHES

CTS206-2	1.75	CTS206-7	1.75
CTS206-4	1.75	CTS206-8	1.95
CTS206-5	1.75	CTS206-9	1.95
CTS206-6	1.75	CTS206-10	1.95

CONNECTORS (GOLD)

DB25P (RS232)	3.25
DB25S Female	3.75
Hood	1.25
Set w/Hood, Sale	$7.50
22/44 W/W, S/T, KIM	2.95
43/86 W/W, S/T, MOT	6.50
50/100 S-100 Connector w/w	4.95
50/100 S-100 Connector s/t	3.95

NAKED PC

Z-80 CPU (Ithaca)	$34.95
8060A CPU	34.95
8K Static RAM (Logos)	24.95
16K Static RAM (2114)	29.95
32K Static RAM (2114)	29.95
8K Eprom (2708)	24.95
1702 Eprom Board	30.00
2708/2716 Eprom (Ithaca)	34.95
2708/2716 Eprom (WMC)	30.00
Realtime Clock	34.95
ACP Proto Bd (3M Conn.)	27.95
Vector 8800 Proto	22.20
Vector 8803 11 slot MB	29.95
ACP Extender w/Conn.	18.95
Video Interface (SSM)	31.95
Parallel Interface (SSM)	31.95
13 Slot MotherBoard (WMC)	32.95
9 Slot MotherBoard (WMC)	29.95
8 Slot Mother (expandable)	34.95
Proc-Tech Bare Boards	CALL
WMC Floppy PCB	34.95

COMPUTER SPECIALS

DISCOUNTS!	LIST	SALE
Apple II Plus w/16K	1195.	990.
PET 2001-16N	995.	895.
Exidy Sorcerer w/16K		1099.
Cromemco Sys III	6990.	6290.
Horizon I w/32K		CALL
Pascal Microengine	1995.	1595.
IPSI 1620 Diablo RO	3295.	2695.
Anadex DP 8000	995.	875.
Centronics Micro S-1	595.	525.
Soroc IO 120	995.	795.
Teletype Model 43	1349.	1150.
HiPlot Plotter	1085.	899.
HiPlot Digitizer	795.	735.
Intertube II	895.	784.
Atari 800	999	750
Atari 400	549	449.
TI 99/4	1150.	1025
Leedex 12" Monitor	149	139
Centronics 737	995	899.
Trencom T-100	375.	349
Trencom T-200	595.	525.
Sanyo 9" Monitor	220	169
Sanyo 15" Monitor	295	249
Mot 22 MHz Monitor	296	219.

FREE CASSETTE
with purchase of Atari 800 or Atari 400. receive any available Programma cassette worth $19.95

SOCKET SPECIALS

14 Pin w/w-2L	$ .35
18 Pin w/w-2L	.55
20 Pin w/w-2L	.75
40 Pin w/w-2L	1.45
18 Pin s/t	.15
22 Pins/t	.15

Call for volume pricing.

TERMS: Use check, M/C, VISA, AMEX, CB, or COD. COD requires 25% deposit. Charge Orders please include expiration date. Foreign pay U.S. Funds. Order by phone, mail or TWX. MINIMUM $10.00. Please include magazine issue and phone no. SHIPPING: U.S.A. add $2.00 for first 2 lbs. For surface add 30¢ for additional lbs. For air add 70¢ for additional lbs. FOREIGN: Add 10% shipping and handling. COD's $1.85 extra. Not responsible for typos. Some items subject to prior sale. We reserve right to limit quantities, some items subject to precious metal adder. Retail pricing may vary from Mail Order. We reserve the right to substitute manufacturer.

RETAIL STORES OPEN MON-SAT
STORE #1 1310 "B" E. Edinger Santa Ana, CA 92705 Showrooms, Retail, Warehouse
STORE #2 674 El Camino Real Tustin, CA 92680 Specializing in Systems

P.O. Box 17329 Irvine, Calif. 92713
Direct Order Lines: (714) 558-8813
(800) 854-8230 or (800) 854-8241

FOR INTERNATIONAL ORDERS:
1401 E. Borchard (714) 953-0604
Santa Ana, CA 92705 TWX: 910-595-1565

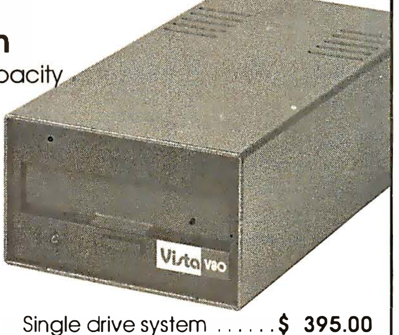
Circle 264 on inquiry card.

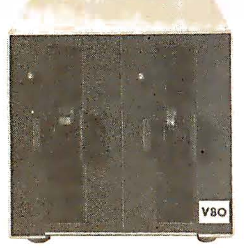
The Supermarket for TRS-80* Add-on Components (and other computers, too)

In stock now. Immediate delivery.

The VISTA V-80 Disk Drive System

- 23%more storage capacity than TRS-80
- 120 day warranty
- 40 track patch at NO CHARGE



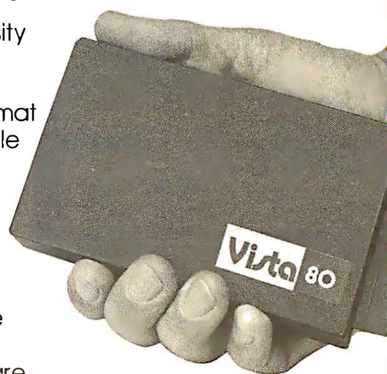


Single drive system	$ 395.00
Two drive system	$ 770.00
Four drive system	$ 1450.00
Two drive cable	$ 29.95
Four drive cable	$ 39.95

The VISTA V-80 Expansion Module

- Provides double density modification to your current Radio Shack interface (lets you format diskettes in either single or double density).
- Increases storage capacity up to 204K bytes (on single 40 track drive).
- Includes all hardware and software.

$239.00



The VISTA Model II

- Provides one, two or three drives.
- Adds up to 1.5 million bytes of on-line storage.
- 120 day warranty
- Does everything Radio Shack's expansion system will do...for less!

$1000.00	Single drive Expansion System
$1550.00	Two drive Expansion System
$2100.00	Three drive Expansion System
$ 525.00	Additional drives alone

The TRS-80 Printers

Centronics 730... **$945.00**
7x7 dot matrix-
80 column

Anadex
DP8000... **$895.00**
9x7 dot matrix-
80 column

VISTA
Printer... **$745.00**
5x7 dot matrix-
80 column

Cables .... **$27.50 each**

Other Products

1. VISTA Verbatim diskettes (hard or soft sector) Certified 40 track .... **$ 38.95**
2. 16K RPM upgrade kits, guaranteed for 120 days. **PRIME PRODUCT** .... **$ 74.50**
3. NEW! DOS + ... **$ 110.00**
4. LNW expansion bare board .... **$ 66.95**
5. H.C. Pennington book, **TRS-80 Disk and Other Mysteries** .... **$ 18.95**
6. DDT Disco-Tech disk drive timer .... **$ 19.95**
7. Cryptext (An Encryption Module) **$299.00**

Add On Drives

MPI B51	40 Track, Double Density-204K	**$275.00**
MPI B52	Dual Head, Double Density-408K	**$375.00**
Siemens	FDD100-5 40 Track Double Density 204K	**$275.00**
Siemens	FDD100-5 Flippy, records both sides	**$290.00**
Siemens	FDD100-8 8" Single Sided Drive	**$448.00**

The VISTA V-200 for Exidy

- Completely packaged system, tested and ready to plug in, includes: power supply, two 40 track drives, case, controller, all cabling and total CPM documentation.
- Storage capacity from 400K to 1.2 meg.
- System software-VISTA CP/M Disk Operating System and BASIC-E Compiler recorded on 5-1/4" diskettes.

Price: Starting as low as **$1199.00**

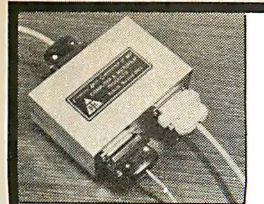


CALL TOLL-FREE 800-854-8017

*TRS-80 is a registered trademark of Radio Shack.

The Vista Computer Company 1401 Borchard Street • Santa Ana, California 92705 • 714/953-0523

Circle 265 on inquiry card.



TERMINAL DATA CORPORATION

MODEL 1200 RS-232 DATA SPLITTER

available in kit form

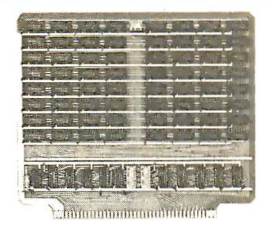
Model 1200K gives the terminal or microprocessor user a second interface for a printer, plotter, cassette or tape drive. It operates at any speed & isolates the two output devices from each other, while providing 2 RS-232 interfaces from the terminal or microprocessor.

The kit consists of 3 RS-232 connectors, printed circuit board, all necessary components, enclosure, mounting hardware & assembly instructions $67.00

write or call

TERMINAL DATA CORP.
11878 Coakley Cir.
Rockville, MD 20852
(301) 881-7655

Circle 266 on inquiry card.

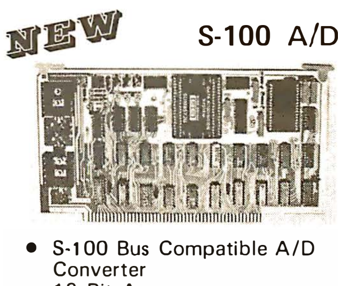


8K BYTE STATIC RAM MODULE FOR THE 6800; COMPATIBLE WITH THE MOTOROLA EXORciser* BUS AND D-2 KIT.
TWO SEPARATE 4k ADDRESSES; EACH MAY BE USED AS RAM OR TREATED AS ROM.
SWITCHES SET ADDRESSES AND CONTROL RAM/ROM OPTION.
ALL IC's ARE SOCKETED; EACH IC HAS A BYPASS CAPACITOR.
ACCESS TIME: 450 NSEC.
DIMENSIONS: HEIGHT 8.425IN. WIDTH 9.750 IN. THICKNESS .062 IN.
SIGNALS: R/W, VMA OR VUA (JUMPER), Ø2
STATIC RAM: LOW POWER 2102AN 4L OR EQUIVALENT.
THE ALI688K COMES ASSEMBLED AND TESTED WITH A ONE YEAR WARRANTY.
PRICE $250

APPLIED LOGIC, INC
P.O. BOX 328
JAMAICA, NEW YORK 11415
(212) 459-4064

*EXORciser is a trademark of Motorola, Inc.

Circle 267 on inquiry card.



- S-100 Bus Compatible A/D Converter
- 12 Bit Accuracy
- 16 Channel Analog Input
- Programmable Gain Amplifier with Sample-and-Hold
- High Quality Commercial/Industrial Construction

2 and 4 Channel, 12 Bit D/A Boards also available.

CDC — CALIFORNIA DATA CORPORATION
3475 Old Conejo Road, Suite C10
Newbury Park, California 91320
(805) 498-3651

Circle 268 on inquiry card.

= Diskettes =

8 inch-soft/hard sector:
Sngl side-sngl dens $2.95
Sngl side-dble dens $3.55
Sngl side-reversbl $4.55
Dble side-sngl dens $4.55
Dble side-dble dens $4.90

5 inch-soft/hard sector:
Sngl side-40 Trk $2.75
Dble side-40 Trk $4.05
Sngl side-77 Trk $4.35

Visa/Mst.Chg/COD — call

[206]488-4552

HARREX CORPORATION
Media Sales Division
P.O. BOX 249
Kenmore, Wash. 98028

Circle 269 on inquiry card.

PASCAL

For programmers learning or desiring to learn PASCAL for the APPLE computer.

LEARN BY EXAMPLE

Three practical-useful PASCAL programs (Text & Code) are now available on minidisk for only $55.00. Filecreate, fileupdate, and filesearch will help you produce in just a very short time. Order today from:

Personal Programs By Victor
P.O. Box 60034
Sunnyvale, CA 94086

(CA Residents add $3.57 Tax)

CUSTOM PROGRAMS UPON REQUEST

Circle 270 on inquiry card.

80X24 VIDEOTERM™

7X9 MATRIX DISPLAY FOR

LOWER CASE W/ DESCENDERS **APPLE II®**



* REGISTERED TRADE MARK OF APPLE COMPUTER INC

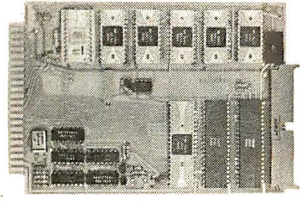
80 columns by 24 lines with easy to read 7x9 dot matrix, upper and lower case with descenders using shift lock feature • 1K firmware incorporates PASCAL and BASIC protocalls so user is not required to enter machine language programs or change PASCALS. Misc. info. or Gotoxy files • Compatible with all APPLE II peripherals so user won't need new software patches for future software products • Crystal controlled dot clock for excellent character stability • VIDEOTERM is the same size as the Apple language card and power consumption is held to a minimum through the use of CMOS and lower power devices • Character set can be user definable up to a maximum of 128 symbols of 8x16 dot matrix font • Display control character mode and four standard display formats controlled by escape sequences • Built in light pen capability • Inverse display mode • 50/60 HZ operation • Sockets on all IC's.

PRICE: Without graphic EPROM $345
OPTIONS: Graphics EPROM line dwg. $25
VIDEO SWITCH PLATE, inserts in case slot to choose between APPLE II* and VIDEOTERM $12
MANUAL: $15



VIDEX 3060 N.W. Thistle Pl. Corvallis, OR 97330 Phone (503) 758-0521

Circle 271 on inquiry card.



SINGLE BOARD COMPUTER $99.50*

with 6800 MPU, 6850 serial I/O, 2 6820 parallel I/O (32 lines), 512 RAM, socket for 2708, 2716, EROM. Interface modules for industrial control, data acquisition, lab instrumentation, on 44 pin 4½"x6½" PCB's. RAM, ROM, CMOS RAM/battery, A/D, D/A, Driver/Sensor, Serial I/O, Parallel I/O, Counter/Timer, IEEE 488 GPIB, floppy controller.

*OEM (500 piece) price



WINTEK Corp.
1801 South Street
Lafayette, IN 47904
Phone (317) 742-8428

Circle 272 on inquiry card.

SAVE 15-50% OF YOUR DISK SPACE

HUFF n PUFF

- Bit compress your files with savings up to 50%
- Cut your TP connect time by up to 50%
- Z-80 code compatible with CP/M and CROMEMCO CDOS
- Free 30 day money back guarantee

HUFF n PUFF is available on 8" diskette, single or double density for $75.

(California residents add 6% sales tax)

J and S SOFTWARE
2406 TORREJON PLACE
CARLSBAD CA. 92008

Circle 273 on inquiry card.



Circle 274 on inquiry card.

H9 OWNERS!

Upgrade your video terminal with one of these long overdue kits:

GRAFIX — Graphical display capabilities assembled and tested $69.95. Kit $59.95.

CURSOR CONTROL — A total of 8 functions assembled and tested $34.95. Kit $29.95.

FLICKER FREE — 4800 baud operation assembled and tested $79.95. Kit $69.95.

All have a full 6 month warranty.

NORTHWEST COMPUTER SERVICES, INC.
8503 N.E. 30th Avenue
Vancouver, WA 98665

Circle 276 on inquiry card.

S-100 VOICE

The ARTICULATOR board allows you to record, store, and playback any vocabulary on your S-100 computer. Input speech is digitized by the ARTICULATOR and sent to the computer via an on-board port for storage at 1K to 2K bytes/sec. This data is then sent back from the computer to the ARTICULATOR for very high quality playback. On-board VOX switching minimizes memory storage requirements.

PRICE — $319 A&T
AVAILABLE NOW

Quintrex, Inc., 9185 Bond
Shawnee Mission, Ks. 66215
(913) 888-3353

Circle 277 on inquiry card.

COMPUTER EQUIPMENT & SOFTWARE BARGAINS



EVERY MONTH

BUY, SELL OR TRADE ALL TYPES OF COMPUTER EQUIPMENT AND SOFTWARE (pre-owned and new) among 20,000 readers nationwide in BIG (11x14") pages. Classified ads are *only* 10¢ per word and are indexed for *easy* and *fast* location. Subscription: $10 a year/12 issues. Money back guarantee.

COMPUTER SHOPPER
P.O. Box F-14
Titusville, FL 32780
(305) 269-3211
MasterCharge or VISA orders only,
Call **TOLL FREE 800-327-9920**

Circle 278 on inquiry card.

12" BLACK & WHITE LOW COST VIDEO TERMINAL

$139.00 LIST
Add $5 for shipping and handling
Texas residents add 5% sales tax.



One year limited warranty

• Ideal for home, personal and business computer systems; surveillance monitors • 12" diagonal video monitor • Composite video input • Compatible with many computer systems • Solid-state circuitry for a stable & sharp picture • Video bandwidth—12 MHz ± 3 DB • Input impedance—75 Ohms • Resolution—650 lines Minimum IN Central 80% of CRT; 550 Lines Minimum beyond central 80% of CRT ref EIA RS-375 • Dimensions—11.375" high; 16.250" wide; 11.250" deep (exclude video input connector) • Weight—6.5 KG (14.3 lbs) net

Use Master Charge/Visa or send money order.

Micro Products Unlimited
P.O. Box 1525, Arlington, TX 76010
817/461-8043
Dealer inquiries welcome

Circle 279 on inquiry card.

APPLE SUPER SALE

16K Apple II or Apple II Plus	**$995.00**
Apple Disk II w/controller	$529.95
Apple Soft or Integer Cards	$159.95
Pascal Language Card	$459.95
10 Megabyte Disk for Apple	$4695.00
DC Hayes Modems	$339.95
Graphics Tablet	$695.00

UCATAN COMPUTER STORE
P.O.BOX 1000 DESTIN FL 32541
ACROSS FROM RAMADA INN
904-837-2022
Credit Cards Accepted

Circle 280 on inquiry card.

FOR SALE:

Unused Polymorphic System 8813 with 32K Ram Memory with floppy disk drives, printer interface and Abern-Sopher Multiwriter III. System has Canadian import tax paid. Offers for complete system to:

Bishop Management,
#8—825 McBride Blvd.,
New Westminster, B. C.,
Canada, V3L 5B5.
(604) 525-8148.

Circle 281 on inquiry card.

dbis

YOUR HEADQUARTERS FOR

OHIO SCIENTIFIC
SALES • SERVICE • SUPPORT

THE BEST NEW YORK AREA PRICES
ON ALL OHIO SCIENTIFIC COMPUTERS
- LOCAL USERS GROUP -
BUSINESS AND PERSONAL SYSTEMS

PROFESSIONAL BUSINESS SOFTWARE:
Accounts Receivable Accounts Payable
Wholesale Industry Distribution
Grants Accounting System
Payroll

ALSO AVAILABLE:
*Eaton LRC 7000+ Plain Paper Printer...$356.
*Okidata Microline 80 Printer-
upper/lower case, graphics, any paper,
software selectable print size........827.
*Hazeltine 1420 Terminal................948.

MASTERCHARGE & VISA WELCOME

Designers & Builders of Information Systems, Inc.
One Mayfair Road - Eastchester, New York 10707

(914)779-5292 (212)933-4170

Circle 282 on inquiry card.

Now on Disk

Learn FORTH

FORTH is a structured high level language that dramatically cuts program development time. You can expand the FORTH language by defining new operations and data types. FORTH programs are compiled to reduce memory space and speed execution.

tinyFORTH is a complete version of the powerful FORTH language tailored to the TRS-80. The disk tinyFORTH system is a stand-alone operating system with FORTH, a text editor, an assembler, and graphics.

Learn FORTH on your own computer. The tinyFORTH user's manual contains hundreds of examples to teach you FORTH in a hands-on style.

tinyFORTH for 16k level II TRS-80:
Disk version and full documentation $49.95
Cassette version and full documentation $29.95
Documentation only (disk version) $14.95

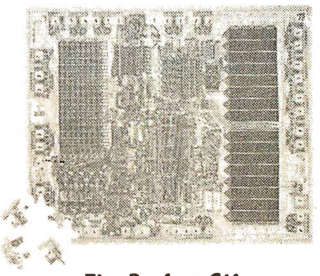
All orders are fully guaranteed. Add $1.50 for postage and handling. Order with check, money order, Visa, or Master-charge.

Write for a FREE booklet describing FORTH.

The Software Farm
Box 2304 Dept. A31 Reston, VA 22090

Circle 283 on inquiry card.

micro-madness



The Perfect Gift for every Computer 'Nut'

An Actual micro-computer chip enlarged 6000% to become a 10" x 14", 252-Piece Jigsaw Puzzle. Send $10.00 ppd. to:

Eubanks Engineering
P.O. Box 127 Valencia, Pa. 16059

Circle 284 on inquiry card.



11542-1 KNOTT ST.
GARDEN GROVE,
CA 92641
(800) 854-6411
(714) 891-2663

8080A
CERAMIC
$2.50 ea.

CAPACITORS
.1 @ 12 VOLTS
CERAMIC
11¢ ea.
100/$10.00

LO-PRO SOCKETS

	1-99	100 UP
14 PIN	.10	.09
16 PIN	.12	.11
18 PIN	.15	.13
20 PIN	.23	.21
24 PIN	.26	.24
28 PIN	.30	.28
40 PIN	.42	.40

MICROBYTE
32K STATIC RAM BOARD
- IEEE/S-100
- 4K Bank Addressable to any 4K Slot within a 64K Boundary
- On-board 8-Bit Output Port
- No DMA Restrictions
- Assembled & Tested
- 4MHz Operation

$475.00

LOBO INT'L
SA800
Shugart 8''
Single-Sided/
Double Density
Floppy Disk
Drive, Cabinet &
Power Supply
(1) Drive Installed
$775.00
(2) Drives Installed
$1250.00

SPECIAL of the MONTH
2114 L-3
LO-POWER/200NS

1-16 .... $4.25
17-49 .... $4.00
50-99 .... $3.75
100 up $3.50

LEEDEX
MODEL #100-80
12" VIDEO MONITOR
80 CHARACTER/24 LINES
$175.00

ATARI
MODEL #800
- New 16K Version
- Computer Console
- Basic Language Program Manual
- Guide to Basic Program Cassette
- Power Supply
- TV Switch Box

(CALL FOR BEST PRICE)
ALSO AVAILABLE
ATARI 410 RECORDER
$60.00

4116's-200NS
ADD-ON MEMORY FOR:
APPLE, TRS-80, HEATH, Exidy,
Sd. Expandoram, etc.
8 for $45.00
or
16 for $85.00

ANACOM GENERAL MODEL - 150 PRINTER
- 9 x 9 Matrix
- Impact Dot
- 150 CPS.
- 10 CPI
- 136 Columns
- 94 ASCII Character
- 6 or 8 Lines per Inch
- Pin Feed & Dual Tractor Drive
- RS-232 or Parallel Interface

CALL FOR PRICE

APPLE II
DISK DRIVE INTERFACE
- SA400, Cabinet, Power Supply & Cable

$395.00
*WITH OPTIONAL INTERFACE CARD
$495.00

VERBATIAM
5¼''
SOFT-SECTOR
DISKETTS
$28.60
BOX OF (10)

2708's
(450NS.)
$7.50 ea.
or
8/$56.00

MICROBYTE
64K DYNAMIC RAM BOARD
- 64K x 8 Bits or 32K x 16 Bits
- S-100 Compatible
- Memory Mapped
- Hidden Refresh
- Assembled & Tested

$590.00 ea.

STATIC & DYNAMIC RAM CHIPS
2104's
(4K) DYNAMICS
$2.00 ea.
5257-3L
(4K) STATIC
$5.25 ea.

SANYO
B & W
MONITORS
9" MODEL
$175.00
15" MODEL
$250.00

2716's
5-Volt Only (450NS.)
$18.00 ea.
MFG. - HITACHI
ALSO AVAILABLE
INTEL'S $21.00

QUME DATATRAK - 8
- Double Sided/Sgl. or Dbl. Density
- 154 Tracks
- 1.2 Megabytes/Disk IBM Format
- 3 MS. Access Time Track to Track

AVAILABLE FROM STOCK
$525.00 ea.

MICROBYTE
16K STATIC RAM BOARD
- S-100 Compatible
- 4K Bank Addressable
- Extended Memory Management
- No DMA Restrictions
- Assembled & Tested
- 4MHz Operation

$240.00

REGULATORS
320T-5 .... .90
320T-12 .... .80
340T-5 .... .75
340T-12 .... .65
78HO5. .... 5.25

74LS240 . . . $1.50
74LS241 . . . $1.40
74LS244 . . . $1.50

CENTRONICS
MODEL #737
- 80 CPS Proportional Spaced
- Dot Matrix (7 x 9) or (7 x 8)
- 96 Character ASCII
- Parallel Interface

$825.00

IMSAI CONN.
100 PIN GOLD
SOLDERTAIL
$2.50 ea.
or
10 for $2.30 ea.

"CAT" ACOUSTIC MODEM
$179.95 with cables
"NEW" D-CAT MODEM
(Direct Connect) $189.95

ORDERING INFO
Name, Address, Phone
Ship by: UPS or Mail
Shipping Charges, Add
$2.00 up to (5) lbs.

TERMS
We Accept Cash,
Check, Money Order,
Visa & Master Charge.
C.O.D.'s on Approval.
(U.S. Funds Only)
Tax: 6% Calif. Res.

Circle 285 on inquiry card.

ROCKWELL AIM 65 USERS

The MDA-65 from Thorson Engineering will:

- Program both 2716 *and* 2532 type EPROMS. These devices will plug directly into the AIM ROM sockets providing up to 12 K bytes of non-volatile program memory.
- Cause your AIM 65 to operate as a *full duplex* 2400 baud terminal.
- Allow rapid downloading of object files from another computer or cassette tape to any RAM address.

The programmer circuit card, software in EPROM, and program listing all for only $135.00 check or money order. Washington residents add 5.3% sales tax.

Thorson Engineering Company
6225 76th St SE
Snohomish, Wa 98290
(206) 334-4214

Circle 286 on inquiry card.

Dial: 402-987-3771

HOT LINE

YOU NEED CRISP, HIGH CONTRAST BLACK-WHITE and VIVID COLOR ALPHA-NUMERICS/GRAPHICS CAPABILITIES FROM YOUR VIDEO MONITOR IF YOU WANT REALLY SUPER-LOOKING IMAGES FROM YOUR COMPUTER!!

Dial:(402) 987-3771

AS SPECIALISTS IN VIDEO IMAGING ...we think we have the right monitor or modulator for your system. Our product line includes the popular "Micro-Verter" (OSI and Apple Inc. approved UHF color modulator), a variety of color and B-W monitors, color cameras, B-W cameras, Audio subcarrier kits and parts. FREE CATALOG UPON REQUEST. Dealers welcomed. Well established program with over 400 dealers.

GET FREE DETAILS VIA OUR HOTLINE!!!

ATV Research 13-B BROADWAY DAKOTA CITY, NE. 68731

PET music BOARD

At last! A music maker for your PET. Our system consists of a small circuit board which plugs into your PET's user port and connects either to a speaker or your hi-fi system (cable included). Our software (on cassette) lets you enter, save, and playback music in up to four voices, each with its own tone colour. Also included are several sample pieces to get you started. When ordering, please specify 8k, 16k, or 32k PET version.
$49 without amp (plugs into your stereo)
$54 with amp (connects to a speaker)
Please use certified cheque or money order.

Electronic Music Systems
45 Livingston Rd. Suite 501
West Hill, Ontario, Canada
M1E 1K8

*PET is a trademark of Commodore B.M.

Circle 288 on inquiry card.

6809 PASCAL

6809 Native code compiler generates romable, position independent output that runs faster than P-Code implementations. Extensions include string and hex data types, case "otherwise" clause and Pascal interface to assembly language. Write for complete specifications.

Compiler package includes compiler, relocating assembler, linking loader, runtime package, interactive symbolic debugger and user manual. We ship on 8" softsector FLEX or MDOS diskettes.

Pricing: CompilerPackage $200.00
for source of runtime add $ 50.00
user manual separately $ 20.00

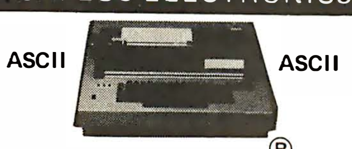
Terms: Check, money order, or COD. CA residents add sales tax. Add 3% (domestic) or 5% (foreign) for shipping and handling.

FLEX is a trademark of TSC
MDOS is a trademark of Motorola

OmegaSoft
P.O. BOX 70265
Sunnyvale CA 94086

Circle 289 on inquiry card.

SURPLUS ELECTRONICS

ASCII  ASCII

IBM SELECTRIC® BASED I/O TERMINAL WITH ASCII CONVERSION INSTALLED $645.00

- Tape Drives • Cable
- Cassette Drives • Wire
- Power Supplies 12V15A, 12V25A, 5V35A Others, • Displays
- Cabinets • XFMRS • Heat Sinks • Printers • Components

Many other items
Send for free catalog
WORLDWIDE ELECT, INC.
130 Northeastern Blvd.
Nashua, NH 03062
Phone orders accepted using VISA or MC
Call Toll Free 1-800-258-1036
IN NH 603-889-7661

Circle 290 on inquiry card.

OSI'ers!

OSI DIDN'T FILL YOU IN... WE WILL... *With the Complete, New OS-65D V3.2 Disassembly Manual.*



- **60 pages of listings**
- **Includes full cross-reference listing**

Order today. Send check for $24.95 to Software Consultants, 7053 Rose Trail, Memphis, Tenn. 38134. 901-377-3503. Postpaid. Allow 2-3 weeks.

Circle 291 on inquiry card.

QUARTZ CRYSTALS

.3218-B	5.2428-B	9.9336-B	20.000-B	36.2886-B	42.8518-B	46.8128-B
.5390-B	5.610-B	9.98408-B	20.4988-B	36.3636-B	42.8768-B	47.3768-B
1.000-A	5.7143-B	9.98960-B	22.1184-B	37.9628-B	42.9258-B	47.8838-B
1.8432-A	5.955-B	10.000-B	22.6258-B	38.3768-B	42.9628-B	48.000-B
1.8437-B	5.982-B	10.2458-B	26.3556-B	38.4448-B	43.0008-B	48.3006-B
2.000-A	6.000-B	10.4968-B	26.5006-B	38.6258-B	43.0378-B	48.6668-B
2.0971-A	6.144-B	10.7755-B	26.6706-B	38.9258-B	43.0748-B	48.7006-B
2.4576-A	6.15030-B	10.8255-B	27.000-B	39.3128-B	43.1858-B	48.8768-B
2.500-A	6.29780-B	10.8386-B	27.0006-B	39.5038-B	43.2598-B	49.7006-B
2.6657-B	6.400-B	11.1360-B	27.6506-B	39.6668-B	43.3338-B	49.7338-B
2.9950-B	6.5536-B	11.155-B	28.4006-B	39.7538-B	43.3708-B	49.8128-B
3.000-A	6.72530-B	11.2186-B	28.6276-B	39.8768-B	43.4078-B	50.2505-B
3.067-B	6.75840-B	11.2890-B	28.7538-B	39.9628-B	43.4378-B	51.0556-B
3.200-B	6.9003-B	11.4776-B	29.8758-B	40.4448-B	43.4448-B	51.3128-B
3.2768-A	7.0063-B	11.6566-B	29.9378-B	40.5928-B	43.5558-B	51.7778-B
3.500-B	7.0336-B	11.6816-B	30.0648-B	40.8128-B	43.6298-B	51.8506-B
3.579-B	7.0916-B	12.440-B	30.3606-B	40.8336-B	43.6668-B	52.8128-B
4.000-B	7.1836-B	14.3182-B	30.6258-B	40.8758-B	43.7778-B	56.7506-B
4.1943-B	7.2586-B	14.4308-B	30.8768-B	40.8888-B	43.8128-B	60.6006-B
4.3426-B	8.000-B	15.000-B	31.4378-B	40.9258-B	43.8148-B	60.7508-B
4.4803-B	8.0556-B	15.4408-B	31.7538-B	41.0008-B	43.8518-B	66.7506-B
4.6103-B	8.1416-B	15.5066-B	31.9008-B	41.1666-B	43.8888-B	70.4006-B
4.6503-B	8.1818-B	16.000-B	32.000-B	41.3768-B	43.9258-B	75.0005-B
4.8303-B	8.3303-B	16.3848-B	33.2006-B	41.9378-B	44.0008-B	90.8338-B
4.9152-B	8.4998-B	17.2248-B	33.6258-B	42.0008-B	44.0378-B	99.9668-B
5.000-B	8.5766-B	17.2422-B	34.5558-B	42.5836-B	44.3768-B	100.6668-B
5.0688-B	8.6056-B	18.000-B	34.7538-B	42.6268-B	44.7778-B	101.4668-B
5.1203-B	8.9608-B	18.4320-B	34.9776-B	42.7006-B	45.1256-B	103.0668-B
5.1850-B	8.9906-B	19.4690-B	35.9256-B	42.7538-B	46.3006-B	103.4668-B
5.1856-B	9.47208-B	19.7508-B	36.000-B	42.8148-B	46.7006-B	104.9918-B

ALL 'A' — $2.99 ALL 'B' — $1.99 10 OR MORE DEDUCT 5%

ADD $1.00 SHIPPING
CAL. RES. ADD 6% SALES TAX
FREE OSCILLATOR SCHEMATICS WITH ANY ORDER

QUALITY COMPUTER PARTS
P.O. BOX 743 / CHATSWORTH, CA 91311

Circle 292 on inquiry card.

MX-8 RELAY MODULES
FOR LOW COST INSTRUMENTATION AND AUTOMATIC TEST

- 8 BIT MICROPROCESSER I/O PORT CONTROL.
- MATRIX MODE — LATCHES ANY OR ALL RELAYS.
- MULTIPLEXER MODE — LATCHES ONLY ONE RELAY.
- CLEAR MODE — OPENS ALL RELAYS.

EXPANSION UP TO 8 MODULES WITH

- PREWIRED CARD CAGE.
- 8 BIT I/O INTERFACE MODULE.
- IEEE 488 BUS INTERFACE MODULE.

Catalogs and detailed applications bulletins from

ATEC SYSTEMS
Box 128, Mendon, N.Y. 14506 716-924-3822

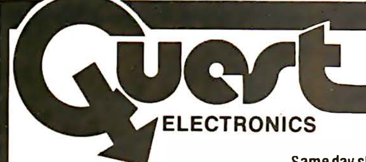
Circle 293 on inquiry card.

68000

Will this be the dominant CPU board of the 80's? The 68000 is coming soon on the IEEE S-100 bus with on-board Z-80 emulation and many other advanced features.

For more information write:
VANDATA
17541 Stone Ave. N.
Seattle, WA 98133
Or call: (206) 542-8370

Circle 294 on inquiry card.



P.O. Box 4430X
Santa Clara, CA 95054
Will calls: 2322 Walsh Ave.
(408) 988-1640

Same day shipment. First line parts only. Factory tested. Guaranteed money back. Quality IC's and other components at factory prices.

INTEGRATED CIRCUITS

7400TTL

7400N	.19
7402N	.20
7404N	.25
7409N	.23
7410N	.20
7414N	.70
7420N	.20
7422N	.39
7430N	.20
7442N	.58
7445N	.74
7447N	.58
7448N	.77
7450N	.20
7474N	.35
7475N	.49
7485N	.88
7489N	1.85
7490N	.43
7492N	.43
7493N	.43
7495N	.69
74100N	1.20
74107N	.35
74121N	.34
74123N	.59
74125N	.45
74145N	.77
74150N	1.20
74151N	.69
74154N	2.00
74157N	.69
74161N	.87
74162N	1.25
74163N	.87
74174N	.96
74175N	.95
74190N	1.15
74192N	.87
74193N	.85
74221N	2.75
74298N	1.65
74365N	.89
74366N	.89
74367N	.89

74LS00 TTL

74LS00N	.35
74LS02N	.35
74LS04N	.55
74LS05N	.40
74LS08N	.45
74LS10N	.45
74LS13N	.55
74LS14N	1.25
74LS20N	.45
74LS22N	.45
74LS28N	.45
74LS30N	.45
74LS33N	.75
74LS38N	.75
74LS74N	1.25
74LS75N	1.00
74LS90N	1.00
74LS93N	1.00
74LS95N	1.10
74LS107N	.65
74LS112N	.65
74LS113N	.45
74LS132N	.89
74LS136N	.65
74LS151N	1.10
74LS155N	1.10
74LS157N	1.10
74LS162N	1.65
74LS163N	1.65
74LS174N	2.00
74LS190N	1.25
74LS221N	2.50
74LS258N	1.60
74LS367N	1.65

LINEAR

CA3045	.90
CA3046	1.10
CA3081	1.80
CA3082	1.90
CA3089	2.95
LM301AN/AH	.35
LM305H	.87
LM307N	.35
LM308N	1.00
LM309K	1.50
LM311H/N	.90
LM317T/K	3.75
LM318	1.35
LM320K-5	1.50
LM323K-5	5.95
LM320K-12	1.50
LM320K-15	1.50
LM320T-5	1.35
LM320T-8	1.35
LM320T-12	1.35
LM320T-15	1.35
LM324N	1.40
LM339N	1.00
LM340K-5	1.35
LM340K-8	1.35
LM340K-12	1.35
LM340K-15	1.35
LM340K-24	1.35
LM340T-5	1.25
LM340T-8	1.25
LM340T-12	1.25
LM340T-15	1.25
LM340T-18	1.25
LM340T-24	1.25
LM350	7.50
LM377	3.50
LM379	5.00
LM380N	1.00
LM381	1.60
LM382	1.60
LM703H	.65
LM709H	.28
LM723H/N	.50
LM733N	.85
LM741CH	.35
LM741N	.38
LM747H/N	.75
LM748N	.35
LM1303N	1.75
LM1304	1.10
LM1305	1.27
LM1307	2.00
LM1310	2.75
LM1458	.47
LM1812	7.50
LM1889	3.00
LM2111	1.75
LM2902	2.25
LM3900N	.60
LM3905	1.75
LM3909N	.95
MC1458V	.50
NE550N	1.00
NE555V	.39
NE556A	.85
NE565A	1.00
NE566V	1.50
NE567V	1.00
NE5708	4.75
78L05	.60
78L08	.60
78M05	.85
75108	1.75
75491CN	.50
75492CN	.55
75494CN	.89

A to D CONVERTER

8038B	4.50
8700CJ	13.95
8701CN	22.00
8750CJ	13.95
LD130	9.95
9400CJV/F	7.40
ICL7103	9.50
ICL7107	14.25

CMOS

CD4000	.25
CD4001	.35
CD4002	.35
CD4006	1.10
CD4007	.35
CD4008	.28
CD4009	.45
CD4010	.45
CD4011	.35
CD4012	.28
CD4013	.47
CD4014	1.25
CD4015	1.00
CD4016	.55
CD4017	1.05
CD4018	.94
CD4019	.45
CD4020	1.02
CD4021	1.35
CD4022	1.10
CD4023	.28
CD4024	.75
CD4025	.28
CD4026	2.50
CD4027	.66
CD4028	.85
CD4029	1.35
CD4030	.45
CD4035	1.35
CD4040	1.35
CD4042	.85
CD4043	.85
CD4044	.85
CD4046	1.67
CD4049	.45
CD4050	.49
CD4051	1.13
CD4060	1.42
CD4066	.71
CD4068	.40
CD4069	.40
CD4070	.50
CD4071	.45
CD4072	.45
CD4073	.45
CD4075	.45
CD4076	1.65
CD4078	.40
CD4081	.35
CD4082	.35
CD4116	.47
CD4490	5.50
CD4507	1.00
CD4508	4.25
CD4510	1.02
CD4511	.94
CD4515	2.52
CD4516	1.10
CD4518	1.02
CD4520	1.02
CD4527	1.51
CD4528	.79
CD4553	3.50
CD4566	2.25
CD4583	2.35
CD4585	1.10
CD40192	3.00
74C00	.35
74C04	.40
74C10	.35
74C14	1.95
74C20	.35
74C30	.35
74C48	2.25
74C74	.85
74C76	1.75
74C90	1.75
74C93	1.75
74C154	3.00
74C160	2.00
74C175	1.35
74C192	2.25
74C221	2.50
74C905	6.00
74C906	.75
74C914	1.95
74C922	6.00
74C923	6.00
74C925	7.50
74C926	6.95
74C927	6.95

INTERFACE

8095	.65
8096	.65
8097	.65
8098	.65
8T09	1.25
8T10	4.50
8T13	3.00
8T20	5.50
8T23	3.10
8T24	3.50
8T25	3.20
8T26	1.69
8T28	2.75
8T97	1.69
8T98	1.69

MOS/MEMORY RAM

2101-1	2.95
2102-1	.95
2102AL-4	1.34
2102AN-2L	1.60
2104A-4	4.95
2107B-4	3.75
2111-1	3.75
2112-2	3.95
2114L 300ns	6.75
2114L 450ns	5.95
4116 200ns	7.95
8/4116 200ns	49.00
2513B	6.30
MM5262	.40
MM5280	3.00
MM5320	9.95
MM5330	5.94
PD411D-3	4.00
PD411D-4	5.00
P5101L	8.95
4200A	9.95
82S25	2.90
91L02A	1.50
HD0165-5	6.95
MM57100	4.50
G1AY38500-1	9.95
MCM66751A	9.95
9368	3.50
410D	10.00
416	16.00

CLOCKS

MM5311	5.50
MM5312	3.90
MM5314	3.90
MM5369	2.10
MM5841	14.45
MM5865	7.95
CT7010	8.95
CT7015	8.95
MM5375AA/N	3.90
MM5375AG/N	4.90
7205	16.50
7207	7.50
7208	15.95
7209	4.95
DS0026CN	3.75
DS0056CN	3.75
MM53104	2.50

MICROPROCESSOR

6502	10.95
6504	9.95
6522	9.95
6800	6.95
6802	11.95
6820	4.95
6850	5.95
8080A	5.95
8085	12.95
8086	75.00
Z80	9.95
Z80A	11.95
8212	2.90
8214	3.95
8216	2.90
8224	3.45
8228	4.95
8251	6.95
8253	15.00
8255	5.75
8257	10.95
8259	14.95
1802CP plas.	13.95
1802DP plas.	17.95
1861P	11.50
CDP1802CD	28.95
CDP1802D	35.00
CDP1861	15.95

UART/FIFO

AY5-1013	5.50
AY5-1014	7.50
3341	6.95

PROM

1702A	4.95
2513B upper case	8.75
2708	7.75
2716TI	18.00
2716 Intel	23.00
6/2716 Intel	160.00
2732	65.00
2758	22.50
8741A	60.00
8748	65.00
8748-8	60.00
8755A	55.00
N82S23	2.95
N82S123	6.50
N82S126	3.75
N82S129	85 0
N82S131	8.50
N82S136	8.75
N82S137	8.75
DM8577	2.90
8223	2.90

CONNECTORS

30 pin edge	2.50
44 pin edge	2.76
100 pin edge	4.50
100 pin edge WW	5.25

IC SOCKETS

Solder Tin Low Profile

PIN	1 UP	PIN	1UP
8	.15	22	.30
14	.14	24	.35
16	.16	28	.42
18	.27	36	.58
20	.29	40	.57

2 level 14 pin ww .20

WIRE WRAP LEVEL 3

PIN		PIN	
14	.32	24	.86
16	.33	28	1.00
18	.57	40	1.23

CRYSTALS

1 MHz	4.50
2 MHz	4.50
4 MHz	4.25
5 MHz	4.25
10 MHz	4.25
18 MHz	3.90
20 MHz	3.90
32MHz	3.90
32768 Hz	4.00
1.8432 MHz	4.50
3.5795 MHz	1.20
2.0100 MHz	1.95
2.097152 MHz	4.50
2.4576 MHz	4.50
3.2768 MHz	4.50
5.0688 MHz	4.50
5.185 MHz	4.50
5.7143 MHz	4.50
6.5536 MHz	4.50
14.31818 MHz	4.25
18.432 MHz	4.50
22.1184 MHz	4.50

KEYBOARD ENCODERS

AY5-2376	$12.50
AY5-3600	17.95
AY5-9100	10.50
AY5-9200	16.50
74C922	5.50
74C923	5.50
HD0165-5	6.95
AY5-9400	10.50

D Connectors RS232

DB25P	3.62
DB25S	5.20
Cover	1.67
DE9S	1.95
DA15P	2.10
DA15S	3.10
Complete Set	9.50

Hickok 3½ Digit LED multimeter	**74.95**
Stopwatch Kit	**26.95**
Auto Clock Kit	**17.95**
Digital Clock Kit	**14.95**

8K/16K Eprom Kit (less PROMS)	$89.00
Motherboard	$39.00
Extender Board	$15.00

RESISTORS ¼ watt 5%
10 per type .03
25 per type .025
100 per type .015
1000 per type .012
350 piece pack
5 per type 6.75
½ watt 5% per type .05

Televideo Terminal
Model 912 $845.00
Model 920 $945.00

Tiny Basic Experimentors Kit **$10.00**

BSR Controller $39.95
Connect your computer to the BSR Home Control System. Computer controlled ultrasonic transmitter for your BSR. Software for 1802 user

KEYBOARDS

56 key ASCII keyboard kit	$67.50
Fully assembled	77.50
53 key ASCII keyboard kit	60.00
Fully assembled	70.00
Enclosure Plastic	14.95
Metal Enclosure	29.95

LEDS

Red T018	.15
Green, Yellow T018	.20
Jumbo Red	.20
Green, Orange, Yellow Jumbo	.25
Cliplite LED Mounting Clips	8/$1.25

(specify red, amber, green, yellow, clear)

CONTINENTAL SPECIALTIES in stock
Complete line of breadboard test equip.
MAX-100 8 digit Freq. Ctr. $128.95

OK WIREWRAP TOOLS in stock
Portable Multimeter $18.00
Complete line of AP Products in stock.

SPECIAL PRODUCTS

MM5865 Stopwatch Timer with 10 pg. spec	9.00
PC board	7.50
Switches Mom. Pushbutton	.27
3 pos. slide	.25
Encoder HD0165-5	6.95
Paratronics 100A Logic Analyzer	**$425.00**
Model 10 Trigger Expander Kit	$229.00
Model 150 Bus Grabber Kit	$369.00
Clock Calendar Kit	**$23.95**
2.5 MHz Frequency Counter Kit	**$37.50**
30 MHz Frequency Counter Kit	**$47.75**

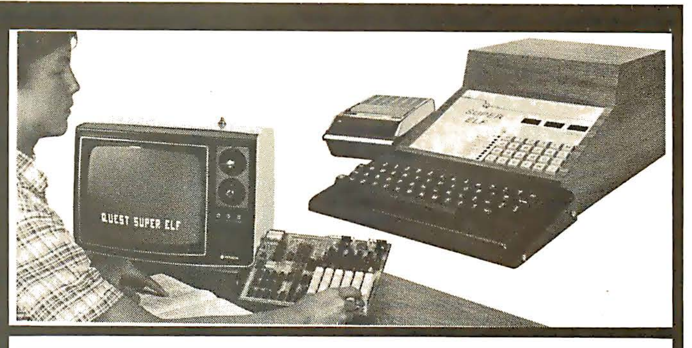
TRANSFORMERS

6V 300 ma	3.25
12 Volt 300ma transformer	1.25
12.6VCT 600ma	3.75
12V 250ma wall plug	2.95
12V CT 250 ma wall plug	3.50
24VCT 400 ma	3.95
10V 1.2 amp wall plug	4.85
12V 6 amp	12.95
12V 500 ma wall plug	4.75
12V 1 amp wall plug	6.50
10/15 VAC 8/16 VA wall plug	9.75

DISPLAY LEDS

MAN1	CA	270	2.90
MAN3	CC	125	.39
MAN72/74	CA/CA	300	1.00
DL704	CC	300	1.25
DL707/DL707R	CA	.300	1.00
DL727/728	CA/CC	.500	1.90
DL747/750	CA/CC	.600	1.95
DL750	CC	.600	1.95
FND359	CC	357	.70
FND500/507	CC/CA	500	1.35
FND503/510	CC/CA	.500	.90
FND800/807	CC/CA	800	2.20
3 digit Bubble			.60
4 digit Bubble			.80
DG8 Fluorescent			1.75
DG10 Fluorescent			1.75
10 digit display			1.25
7520 Clairex photocells			.39
TIL311 Hex			9.50
MAN3640	CC	.30	1.10
MAN4610	CA	.40	1.20
MAN4640	CC	.40	1.20
MAN4710	CA	.40	.95
MAN4740	CC	.40	1.20
MAN6640	CC	.56	2.95
MAN6710	CA	.60	1.35
MAN6740	CC	.60	1.35

MA1002A	**8.95**
MA1002E	**8.95**
MA1012A	**8.95**
102P3 transformer	**2.25**
MA1012A Transformer	**2.25**



RCA Cosmac 1802 Super Elf Computer $106.95

Compare features before you decide to buy any other computer. There is no other computer on the market today that has all the desirable benefits of the **Super Elf** for so little money. The Super Elf is a small single board computer that does many **big** things. It is an excellent computer for training and for learning programming with its machine language and yet it is easily **expanded** with **additional memory, Full Basic, ASCII Keyboards, video character generation, etc.**

Before you buy another small computer, see if it includes the following features: ROM monitor; State and Mode displays; Single step; Optional address displays; Power Supply; Audio Amplifier and Speaker; Fully socketed for all IC's; Real cost of in warranty repairs; Full documentation.

The **Super Elf** includes a **ROM** monitor for program loading, editing and execution with **SINGLE STEP for program debugging** which is not included in others at the same price. With **SINGLE STEP** you can see the microprocessor chip operating with the **unique Quest** address and data bus displays **before, during** and **after** executing instructions. Also, CPU mode and instruction cycle are decoded and displayed on 8 LED indicators.

An RCA 1861 **video graphics** chip allows you to connect to your own TV with an inexpensive video modulator to do graphics and games. There is a **speaker system** included for writing your own music or using many music programs already written. The speaker amplifier may also be used to drive relays for control purposes.

A 24 key **HEX keyboard** includes 16 HEX keys plus **load, reset, run, wait, input, memory protect, monitor select** and **single step.** Large, on board displays provide output and optional **high and low address.** There is a 44 pin standard connector slot for PC cards and a 50 pin connector slot for the Quest Super Expansion Board. Power supply and sockets for **all** IC's are included in the price plus a detailed 127 pg. instruction manual which now includes over 40 pgs. of software info. including a series of lessons to help get you started and a music program and graphics target game. Many schools and universities are using the Super Elf as a course of study. OEM's use it for training and R&D.

Remember, other computers only offer Super Elf features at additional cost or not at all. **Compare before you buy. Super Elf Kit $106.95, High address option $8.95, Low address option $9.95. Custom Cabinet** with drilled and labelled plexiglass front panel **$24.95.** All metal Expansion Cabinet, painted and silk screened, with room for 5 S-100 boards and power supply **$57.00. NiCad Battery Memory Saver Kit $6.95.** All kits and options also completely assembled and tested.

Questdata, a software publication for 1802 computer users is available by subscription for $12.00 per 12 issues. Single issues $1.50. Issues 1-12 bound $16.50.

Tiny Basic Cassette **$10.00**, on ROM **$38.00**, original Elf kit board **$14.95. 1802 software;** Moews Video Graphics **$3.50.** Games and Music **$3.00,** Chip 8 Interpreter **$5.50.**

Super Expansion Board with Cassette Interface $89.95

This is truly an astounding value! This board has been designed to allow **you** to decide how you want it optioned. **The Super Expansion Board comes with 4K of low power RAM** fully addressable anywhere in 64K with built-in memory protect and a **cassette interface.** Provisions have been made for all other options on the same board and it fits neatly into the hardwood cabinet alongside the **Super Elf.** The board includes slots for up to 6K of **EPROM** (2708, 2758, 2716 or TI 2716) and is **fully socketed.** EPROM can be used for the monitor and Tiny Basic or other purposes.

A 1K Super ROM Monitor $19.95 is available as an on board option in 2708 EPROM which has been preprogrammed with a program loader/editor and error checking multi file cassette read/write software, (relocatable cassette file) another exclusive from Quest. It includes register save and readout, block move capability and video graphics driver with blinking cursor. Break points can be used with the register save feature to isolate program bugs quickly, then follow with single step. If you have the **Super Expansion Board** and **Super Monitor** the monitor is up and running at the push of a button.

Other on board options include **Parallel Input and Output Ports** with **full handshake.** They allow easy connection of an ASCII keyboard to the input port. **RS 232 and 20 ma Current Loop** for teletype or other device are on board and if you need more memory there are two **S-100** slots for static RAM or video boards. Also a 1K Super Monitor version 2 with video driver for full capability display with Tiny Basic and a video interface board. **Parallel I/O Ports $9.85, RS 232 $4.50, TTY 20 ma I/F $1.95, S-100 $4.50. A 50 pin connector set** with ribbon cable is available at $15.25 for easy connection between the **Super Elf** and the **Super Expansion Board.**

Power Supply Kit for the complete system (see Multi-volt Power Supply).

Announcing Quest Super Basic— *SECOND GENERATION*

A new enhanced version of **Super Basic** now available. Quest was the first company worldwide to ship a full size Basic for 1802 Systems. A complete function **Super Basic** by **Ron Cenker** including floating point capability with scientific notation (number range $\pm.17E^{38}$), 32 bit integer $\pm$2 billion; multi dim arrays, string arrays; string manipulation; cassette I/O; save and load, basic, data and machine language programs; and over 75 statements, functions and operations.

Enhancements include increased speed, built-in provisions for Stringy Floppy, Floppy Disc, Printer Driver, I/O, user definable command library and statement renumbering.

Easily adaptable to most 1802 systems. Requires 16K RAM minimum for Basic and user programs. Source listing for both Serial and Parallel I/O included.

Super Basic on Cassette $40.00.

PROM Eraser

assembled. 25 PROM capacity **$37.50** (with timer **$69.50**). 6 PROM capacity OSHA/UL version **$69.50** (with timer **$94.50**).

Z80 Microcomputer

16 bit I/O, 2 MHz clock, 2K RAM, ROM Breadboard space. Excellent for control. Bare Board **$28.50.** Full Kit **$99.00.** Monitor **$20.00.** Power Supply Kit **$35.00. Tiny Basic $30.00**

S-100 Computer Boards

8K Static Godbout Econo IIA Kit	145.00
16K Static Godbout Econo XIV Kit	285.00
24K Static Godbout Econo VIIA-24 Kit	435.00
32K Static Godbout Econo X-32 Kit	575.00
16K Dynamic RAM Kit	199.00
32K Dynamic RAM Kit	310.00
64K Dynamic RAM Kit	470.00
Video Interface Kit	**$135.00**

80 IC Update Master Manual $55.00

Comp. IC data selector, 2700 pg. master reference guide. Over 51,000 cross references. Free update service through 1980. Domestic postage $3.50.

Modem Kit $60.00

State of the art, orig., answer. No tuning necessary. 103 compatible 300 baud. Inexpensive acoustic coupler plans included.

LRC 7000+Printer $389.00

40/20 column dot matrix impact, std. paper. Interface all personal computers.

64/40/32/20 version **$405.00.** Optional cables available.

LRC 7000 printer interface cable for Super Elf with software **$26.00**

NiCad Battery Fixer/Charger Kit

Opens shorted cells that won't hold a charge and then charges them up, all in one kit w/full parts and instructions. **$7.25**

Rockwell AIM 65 Computer

6502 based single board with full ASCII keyboard and 20 column thermal printer. 20 char. alphanumeric display, ROM monitor, fully expandable. **$375.00.** 4K version **$450.00.** 4K Assembler **$85.00,** 8K Basic Interpreter **$100.00.**

Special small power supply for AIM65 assem. in frame **$54.00.** Complete AIM65 in thin briefcase with power supply **$499.00.** Molded plastic enclosure to fit both AIM65 and power supply **$47.50.** Special Package Price: 4K AIM, 8K Basic, power supply, cabinet **$599.00**

AIM65/KIM/VIM/Super Elf 44 pin expansion board; 3 female and 1 male bus. Board plus 3 connectors **$22.95.**

60 Hz Crystal Time Base Kit $4.40

Converts digital clocks from AC line frequency to crystal time base. Outstanding accuracy.

Video Modulator Kit $8.95

Convert TV set into a high quality monitor w/o affecting usage. Comp. kit w/full instruc.

Multi-volt Computer Power Supply

8v 5 amp, ±18v .5 amp, 5v 1.5 amp, −5v .5 amp, 12v .5 amp, −12v option. ±5v, ±12v are regulated. Basic Kit **$29.95.** Kit with chassis and all hardware **$43.95.** Add $4.00 shipping. Kit of hardware **$14.00.** Woodgrain case **$10.00.** $1.50 shipping.

Gremlin Color Video Kit $69.95

32 x 16 alpha/numerics and graphics; up to 8 colors with 6847 chip; 1K RAM at E000. Plugs into Super Elf 44 pin bus. No high res. graphics. On board RF Modulator Kit **$4.95**

1802 16K Dynamic RAM Kit $149.00

Expandable to 32K. Hidden refresh w/clocks up to 4 MHz w/no wait states. Addl. 16K RAM **$63.00**

Super Elf 44 pin expansion board; 3 female and 1 male bus. Board plus 3 connectors **$22.95**

Tiny Basic Extended on Cassette **$15.00**
(added commands include Stringy, Array, Cassette I/O etc.)

S-100 4-Slot Expansion **$ 9.95**
Super Monitor VI.I Source Listing **$15.00**

Elf II Adapter Kit $24.95

Plugs into Elf II providing Super Elf 44 and 50 pin plus S-100 bus expansion. (With Super Expansion). High and low address displays, state and mode LED's optional **$18.00.**

SuperColor S-100 Video Kit $129.95

Expandable to 256 x 192 high resolution color graphics. 6847 with all display modes computer controlled. Memory mapped. 1K RAM expandable to 6K. S-100 bus 1802, 8080, 8085, Z80 etc.

Editor Assembler **$25.00**
(Requires minimum of 4K for E/A plus user source)

1802 Tiny Basic Source listing **$19.00**
Super Monitor V2.0/2.1 Source Listing **$20.00**

TERMS: $5.00 min. order U.S. Funds. Calif residents add 6% tax.
$10.00 min. order BankAmericard and Master Charge and COD. $1.00 insurance optional.
Shipping charges will be added on charge cards.

FREE: Send for your copy of our NEW 1980 QUEST CATALOG. Include 48¢ stamp.

Circle 295 on inquiry card.

CROSS-ASSEMBLERS

WRITTEN IN ANSI FORTRAN IV

PACKAGE NO.	MACHINE(S)
XASM6800	MC6800,02,08
XASM6801	MC6801
XASM6805	MC6805
XASM6809	MC6809
XASM8085	8080,8085
XASM1802	CDP1802
XASM6502	6500 FAMILY

Full instruction set, all addressing modes. Free-format input, relocatable listing and object module, many user-selectable assembly options. 8-character labels, arithmetic expressions in operands, long error messages, high execution speed.

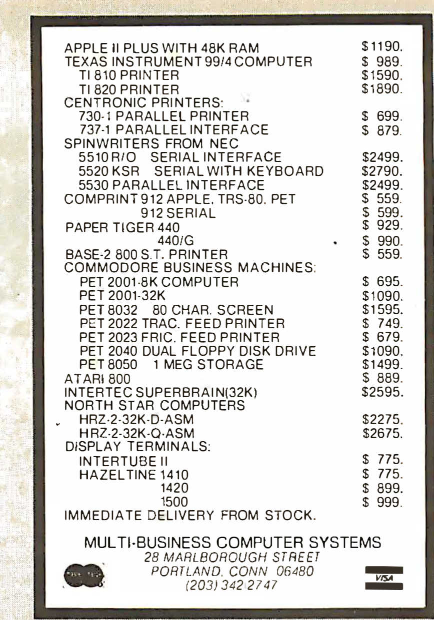
Full-capability assemblers run on almost any system supporting ANSI standard FORTRAN IV, 1966 or later, at a fraction of the cost of a separate development system.

FORTRAN SOURCE MEDIA	PRICE
MAGNETIC TAPE PACKAGE	$75.00
PUNCHED CARD PACKAGE	$50.00
MANUAL/LISTING ALONE	$20.00

Packages include manual/listing, shipping in U.S.A. For cards, specify punch code. For tape, specify code, BPI, block size.

IDM
P.O. Box 14538
Minneapolis, MN 55414
(612)-722-1702

Circle 296 on inquiry card.



APPLE II PLUS WITH 48K RAM	$1190.
TEXAS INSTRUMENT 99/4 COMPUTER	$ 989.
TI 810 PRINTER	$1590.
TI 820 PRINTER	$1890.
CENTRONIC PRINTERS:	
730-1 PARALLEL PRINTER	$ 699.
737-1 PARALLEL INTERFACE	$ 879.
SPINWRITERS FROM NEC	
5510 R/O SERIAL INTERFACE	$2499.
5520 KSR SERIAL WITH KEYBOARD	$2790.
5530 PARALLEL INTERFACE	$2499.
COMPRINT 912 APPLE, TRS-80, PET	$ 559.
912 SERIAL	$ 599.
PAPER TIGER 440	$ 929.
440/G	$ 990.
BASE-2 800 S.T. PRINTER	$ 559.
COMMODORE BUSINESS MACHINES:	
PET 2001-8K COMPUTER	$ 695.
PET 2001-32K	$1090.
PET 8032 80 CHAR. SCREEN	$1595.
PET 2022 TRAC. FEED PRINTER	$ 749.
PET 2023 FRIC. FEED PRINTER	$ 679.
PET 2040 DUAL FLOPPY DISK DRIVE	$1090.
PET 8050 1 MEG STORAGE	$1499.
ATARI 800	$ 889.
INTERTEC SUPERBRAIN(32K)	$2595.
NORTH STAR COMPUTERS	
HRZ-2-32K-D-ASM	$2275.
HRZ-2-32K-Q-ASM	$2675.
DISPLAY TERMINALS:	
INTERTUBE II	$ 775.
HAZELTINE 1410	$ 775.
1420	$ 899.
1500	$ 999.

IMMEDIATE DELIVERY FROM STOCK.

MULTI-BUSINESS COMPUTER SYSTEMS
28 MARLBOROUGH STREET
PORTLAND, CONN 06480
(203) 342-2747

VISA

Circle 297 on inquiry card.



Shugart Floppy Disk Driver

3M Floppy Discs

TMS 2532 *4K bytes EPROM 450ns Single 5V*

SN74SXX Series Schottky I.C.

U.S. SERVEX Inc.
10322B N. Stelling Rd.
Cupertino, CA 95014
(408) 252-4217

Circle 298 on inquiry card.



Let The Purchasing Agent buy wholesale for you.

Save up to 50%

Over 200 computers, CRT's and printers plus software. Compare:

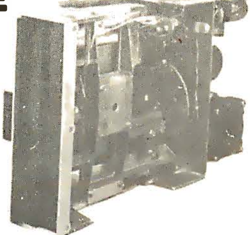
	Whse.		Whse.
TI-810 Printer	$1,383	TVI 912C	$ 699
Cromemco Sys-3 64K	5,346	Diablo 1640	2,627
Soroc IQ-120	680	Alpha Micro 10Meg	10,185
Qume Sprint 5	2,285	Zenith Z-89 48K	2,069
NorthStar Hor2 32K	2,179	WordStar	250

THE PURCHASING AGENT
(415) 540-8119
Hotel Claremont, Berkeley, CA 94705

Circle 299 on inquiry card.

DISK DRIVE/CRT SALE

Shugart SA801R for RS MOD. II Only $468



Hazeltine 1000 (unused)	$299
Shugart SA 400	$279
Pertec FD2000 .... $279 FD250	$359
MPI B51 .... $279 B52	$349
SA 01R w/PS/Cab	$749
Dual Drives w/PS/Cab	$1499

Limited Quantities

MTI
3304 W. MacArthur Blvd.
Santa Ana, CA 92704
(714) 979-9923

Circle 300 on inquiry card.

LOW PRICES

Most all brands. Micro/Minis, terminals, printers, and accessories

Atari 400	$ 495.
Commodore 8016.	$1270.
Soroc IQ120	$ 739.
Qume 5/45 RO ..	$2560.
Base 2 800ST ...	$ 539.
Novation CAT	$ 155.
Wordstar	$ 399.

Send for our catalog or call us (you'll get up to a $3.00 credit for the call on your order) for technical consultation or quotation. All items cashier's check only and shipped freight collect.

SP ELECTRONICS
P.O. Box 8265
Sacramento, CA 95818
(916) 442-2323

Circle 301 on inquiry card.

STATIC RAM CHIPS

FACTORY PRIME From the same shipment we use in our professional quality boards.

2114L 450 ns . **$5.90** 200 ns . $6.90
4044 450 ns . . **$5.90** 250 ns . $6.90
Add $5.00 Handling on Orders Under $200.00

32K STATIC RAM BOARD

FOR THE SS50 AND SS50C BUS (SWTP etc.)

- SS50C Extended Addressing (can be disabled).
- 4 separate 8K blocks.
- Low power 2114L RAMS
- Socketed for 32K
- Write Protect
- Gold Bus Connectors

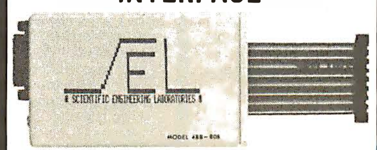
16K	$328.12
24K	$438.14
32K	$548.15

Phone, write, or see your dealer for details and prices on our broad range of Boards and Systems for the SS50/SS50C bus including our ***UNIQUE 80x24 VIDEO BOARD***, and our AC Power Control Products for all computers.

GIMIX Inc.
1337 W. 37th Place • Chicago, IL 60609
(312) 927-5510 • TWX 910-221-4055
The Company that delivers.
Quality Electronic products since 1975.
GIMIX® and GHOST® are Registered Trademarks of GIMIX INC.

Circle 302 on inquiry card.

IEEE-488 To TRS-80* INTERFACE



MODEL 488-80B $225.00
(plus shipping, ins. & tax)

EVERYTHING NEEDED TO ADD POWERFUL GPIB-488 CONTROLLER CAPABILITY TO TRS-80 MODEL 1, LEVEL 2 OR DOS

SCIENTIFIC ENGINEERING LABORATORIES
11 Neil Drive • Old Bethpage, NY 11804
Telephone: (516) 694-3205

*Trade Mark of Tandy Corporation. There is no affiliation between Scientific Engineering Laboratories and Tandy Corporation or Radio Shack.

Circle 303 on inquiry card.

SURPLUS INVENTORY

$77  **22 MHz BANDWIDTH**

SOLID STATE MONITORS: Sylvania 12" B&W CRT, 22MHz video bandwidth, 800 line resolution! ASL Model C12ACB. OEM tabletop style without case, P4 phosphor. Inputs = separate video, horiz. & vert. pos. sync pulses at nominal TTL/CMOS levels. Any sweep rate, 10-20 KHz. 115 VAC. Simple TRS-80 hookup, add 2 jumpers. With full maint. mainual incl. timing, schematics, TRS-80 hookup etc. Slightly used and like new, checked, $88. Used, checked, no burns $77

FLOPPY POWER SUPPLIES (6 OUTPUTS): North #3676, brand new in orig. foam boxes. 5V/3A, 24V/1.2A, 16V/2.6A (all adjustable, w/OV prot. & curr. limiting); 12V/0.1A, -24V/0.3A (both w/OV prot.); -12V/0.1A (adj.). Fully regulated, linear, partially encl., w/schts & assy. dwgs. 3.5×5.5×14". 115VAC. Will run 1 typical 8" floppy or drop the 16V to 12 and run 2 or 3 minifloppies $44

S100 CORE SALE: Brand new, tested Ampex core. See article "ITS TIME FOR CORE" (9/79 Kilobaud p. 34) which describes an easily built interface between this core and an S-100 machine. But ignore the prices in the article! Sale priced, including large documentation pkg. Non-volatile. 16K-byte boards .... $199.
Add $4 for schematics of core.

OTHER SURPLUS BARGAINS: **LETTER QUALITY ASCII KSR TERMINALS,** Perkin Elmer Carousel 20ma $1600, RS-232 $1800, FOB. **PORTACOM** portable terminals w/built-in coupler, 110 baud, impact, technician special, AS-IS $250, checked $450, FOB.

WRITE OR CALL FOR FULL SPEC SHEETS ON SPECIFIC ITEMS.

TERMS: UPS included 48 states except FOB items. UPS COD add $2.00. VISA & MC add 4%. NJ add sales tax. Everything guaranteed working to specs. Immediate shipment or immediate refund. Phone orders and questions are welcome.

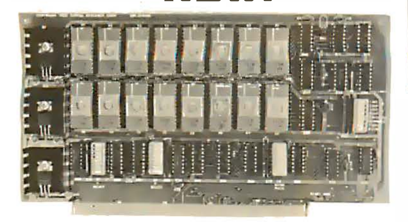
ELECTRAVALUE INDUSTRIAL
P.O. BOX 157-B
MORRIS PLAINS, NJ 07950

Phone orders are welcome.
201/267-1117

Circle 305 on inquiry card.

DIGITAL RESEARCH COMPUTERS
(214) 271-3538

32K S-100 EPROM CARD
NEW!



$74.95
KIT

USES 2716's

Blank PC Board - $34

ASSEMBLED & TESTED ADD $30

SPECIAL: 2716 EPROM s (450 NS) Are $19.95 EA. With Above Kit.

KIT FEATURES:
1. Uses +5V only 2716 (2Kx8) EPROM's.
2. Allows up to 32K of software on line!
3. IEEE S-100 Compatible.
4. Addressable as two independent 16K blocks.
5. Cromemco extended or Northstar bank select.
6. On board wait state circuitry if needed.
7. Any or all EPROM locations can be disabled.
8. Double sided PC board, solder-masked, silk-screened.
9. Gold plated contact fingers.
10. Unselected EPROM's automatically powered down for low power.
11. Fully buffered and bypassed.
12. Easy and quick to assemble.

16K DYNAMIC RAM PARTIALS

LOOK! **INTEL 2108 8K X 1 RAMS** LOOK!
8 FOR $9.95 32 FOR $35
FACTORY PRIME!

Huge special purchase of INTEL Dynamic RAM's. These are 2108-4, 300NS, 8K, Ceramic DIP. The 2108 is the INTEL 2116 (16K) tested for either upper or lower 8K only. These are factory prime. Full Spec. See INTEL 1978 Cat. for details or Memory Design Handbook for application data. Both IMSAI and EXTENSYS did mfq. S-100 RAM boards using these devices. — P.S. These devices will not work in the SD EPANDORAM™. Please specify upper or lower 8K. (S1626 or S1627). A super easy RAM to interface to a Z80, 16 PIN DIP.

FOR 4MHZ **SALE!** **LOW POWER - 300NS** **8 FOR $44**

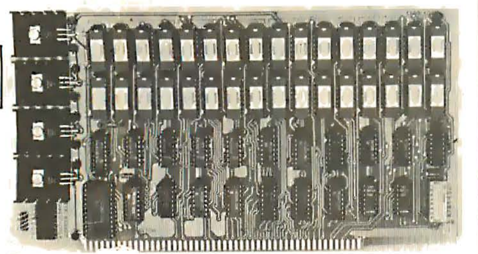
2114 RAM SALE!

4K STATIC RAM'S. MAJOR BRAND, NEW PARTS.
These are the most sought after 2114's, LOW POWER and 300NS FAST.
8 FOR $44

16K STATIC RAM KIT-S 100 BUSS

PRICE CUT!
$225 KIT





KIT FEATURES:
1. Addressable as four separate 4K Blocks.
2. ON BOARD BANK SELECT circuitry. (Cromemco Standard!). Allows up to 512K on line!
3. Uses 2114 (450NS) 4K Static Rams.
4. ON BOARD SELECTABLE WAIT STATES.
5. Double sided PC Board, with solder mask and silk screened layout. Gold plated contact fingers.
6. All address and data lines fully buffered.
7. Kit includes ALL parts and sockets.
8. PHANTOM is jumpered to PIN 67.
9. LOW POWER: under 1.5 amps TYPICAL from the +8 Volt Buss.
10. Blank PC Board can be populated as any multiple of 4K.

BLANK PC BOARD W/DATA-$33
LOW PROFILE SOCKET SET-$12
SUPPORT IC'S & CAPS-$19.95
ASSEMBLED & TESTED-**ADD $35**

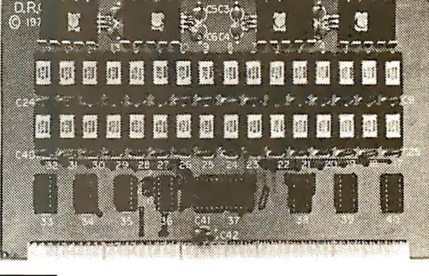
OUR #1 SELLING RAM BOARD!

16K STATIC RAM SS-50 BUSS

PRICE CUT!
$229 KIT

FULLY STATIC!

FOR 2MHZ ADD $10



FOR SWTPC 6800 BUSS!

ASSEMBLED AND TESTED - $35

KIT FEATURES:
1. Addressable on 16K Boundaries
2. Uses 2114 Static Ram
3. Fully Bypassed
4. Double sided PC Board. Solder mask and silk screened layout.
5. All Parts and Sockets included
6. Low Power: Under 1.5 Amps Typical

BLANK PC BOARD—**$30** COMPLETE SOCKET SET—**$12**
SUPPORT IC'S AND CAPS—**$19.95**

STEREO! S-100 SOUND COMPUTER BOARD
NEW! NEW!

At last, an S-100 Board that unleashes the full power of two unbelievable General Instruments AY3-8910 NMOS computer sound IC's. Allows you under total computer control to generate an infinite number of special sound effects for games or any other program. Sounds can be called in BASIC, ASSEMBLY LANGUAGE, etc.

KIT FEATURES:
- TWO GI SOUND COMPUTER IC'S.
- FOUR PARALLEL I/O PORTS ON BOARD.
- USES ON BOARD AUDIO AMPS OR YOUR STEREO.
- ON BOARD PROTO TYPING AREA.
- ALL SOCKETS, PARTS AND HARDWARE ARE INCLUDED.
- PC BOARD IS SOLDERMASKED, SILK SCREENED, WITH GOLD CONTACTS.
- EASY, QUICK, AND FUN TO BUILD. WITH FULL INSTRUCTIONS.
- USES PROGRAMMED I/O FOR MAXIMUM SYSTEM FLEXIBILITY.

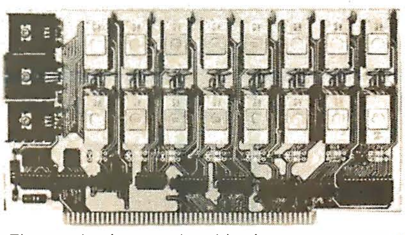
Both Basic and Assembly Language Programming examples are included.

COMPLETE KIT! $84.95 (WITH DATA MANUAL)

BLANK PC BOARD W/DATA $31

SOFTWARE:
SCL™ is now available! Our Sound Command Language makes writing Sound Effects programs a SNAP! SCL™ also includes routines for Register-Examine-Modify, Memory-Examine-Modify, and Play-Memory. SCL™ is available on CP/M* compatible diskette of 2708 or 2716. Diskette-**$24.95** 2708 - **$19.95** 2716 - **$29.95** Diskette includes the source. EPROM'S are ORG at E000H.

16K EPROM CARD-S 100 BUSS



$59.95
KIT

BLANK PC BOARD - $28

USES 2708's!

Thousands of personal and business systems around the world use this board with complete satisfaction. Puts 16K of software on line at **ALL TIMES!** Kit features a top quality soldermasked and silk-screened PC board and first run parts and sockets. Any number of EPROM locations may be disabled to avoid any memory conflicts. Fully buffered and has WAIT STATE capabilities.

ASSEMBLED AND FULLY TESTED — ADD $30

OUR 450 NS 2708'S ARE $8.95 EA. WITH PURCHASE OF KIT

RCA CMOS COMPUTER CHIP SET

INCLUDES:

1-CDP1802CD CPU	1-CDP1861CD VIDEO IC
2-CDP1822CE 256 x 4 RAM	1-CDP1862CE COLOR GEN.
1-CDP1858CE 4 BIT LATCH	1-CDP1863CE SOUND GEN.

COMPLETE SET $45 **LIMITED QTY**

NEW! G.I. COMPUTER SOUND CHIP

AY3-8910. As featured in July, 1979 BYTE! A fantastically powerful Sound & Music Generator. Perfect for use with any 8 Bit Microprocessor. Contains: 3 Tone Channels. Noise Generator, 3 Channels of Amplitude Control. 16 bit Envelope Period Control, 2-8 Bit Parallel I/O. 3 D to A Converters, plus much more! All in one 40 Pin DIP. Super easy interface to the S-100 or other busses.

SPECIAL OFFER: $14.95 each Add $3 for 60 page Data Manual.

Digital Research Computers
(OF TEXAS)

P.O. BOX 401565 • GARLAND, TEXAS 75040 • (214) 271-3538

TERMS: Add $1.25 postage. We pay balance. Orders under $15 add 75¢ handling. No. C.O.D. We accept Visa and MasterCharge. Tex. Res. add 5% Tax. Foreign orders (except Canada) add 20% P & H. 90 Day Money Back Guarantee on all items. Orders over $50, add 85¢ for insurance.

***TRADEMARK OF DIGITAL RESEARCH.** **NOT ASSOCIATED WITH DIGITAL RESEARCH OF CALIFORNIA, THE SUPPLIERS OF CPM SOFTWARE.**

Circle 315 on inquiry card.

NORTH STAR BASIC CROSSREFERENCE

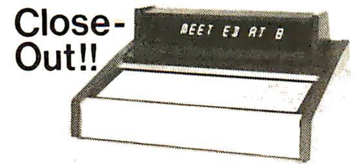
This Basic program prints or displays a sectionalized fully sorted line number index to transfers of control (both from/to and to/from), numeric variables, numeric arrays, numeric functions, character variables, character functions, and three sections of basic keywords. A 30 block program (apprx. 1000 indices) analyzed and printed in 15 minutes.

Multi program-file input and configurable output width (32-80). To analyze 60 block programs you need 16K user area, disk and Rel. 4.0 or later. Larger programs easily accommodated with more memory. Delivered on single density for use on all density North Star drives. Fully annotated source with implementation and use instructions is $30.00 from:

J. McCarron Software
2021 N. 22nd St.
Phoenix, Arizona 85006
(602) 244-9408

Circle 316 on inquiry card.

Close-Out!!



Desk Top Computer

This unit is a computerized Electronic Secretary. It keeps time, date, calendar, message, and meeting files. Originally sold thru a major mail order house for over $450.00.

Technically, it's a 6507 MICRO, ROM, Ram, Planaplex Alpha Display, Ni-cad Battery, Power Supply, Keyboard, Wood and Aluminum Case with Schematic and Instructions.

Most of these Computers are warranty returns. We are offering refurbished like new units for **$99.95** and *as is* (most have minor problems) units for **$44.95**. Add **$4.95** per unit for shipping and handling per unit ordered. All units are complete as described. All sales are final. California Residents add 6.5% Sales Tax.

Send Payment and Order to:

Solid State Surplus
P.O. Box 32418/San Jose, CA 95152

Circle 317 on inquiry card.

Floppys & Systems Repair

DRIVES

- *Per Sci - Shugart*
- *Pertec - Micropolis*

COMPUTERS

- *Apple - TRS-80*

Computer Service Center
1023 N. La Brea
Hollywood, CA 90038
(213) 851-2226

Circle 318 on inquiry card.

BELOW DEALERS COST!



North Star Horizon
(FACTORY TESTED AND ASSEMBLED)

32 K DD — 2295.00
32 K QUAD — 2600.00

16K and a 32K RAM boards

Application Software

North Star Pascal $160.00 — NorthWord $335.00 — General Ledger $825.00 — Info Manager $395.00 — North Star BASIC — Mail Manager $245.00 — Accounts Receivable $475.00 — Accounts Payable $475.00

COD · CASH IN ADVANCE · VISA / MASTER CHARGE*
* ADD 2 PERCENT ON CHARGE ORDERS



CUSTOM BUSINESS COMPUTERS
103 ATLANTIC AVENUE, LYNBROOK, NEW YORK 11563 · (516) 887-1500 or 887-3340

Circle 319 on inquiry card.

ONLY $950

(Qty 6 or more)

DEC LA-34

Friction Feed, paper width to 15 inches

CALL TOLL FREE
800-638-3230

IN MARYLAND CALL
301-636-5680

ASK FOR DATA TERMINAL DIVISION

JINSAM™ Data Manager

- ★ CUSTOM DATA FILES
- ★ FAST/EASY/MENU DRIVEN
- ★ HELP COMMANDS
- ★ KEYED RANDOM ACCESS
- ★ MULTIPLE SEARCH KEYS
- ★ PRIVACY ACCESS CODES
- ★ WILD CARD SEARCH

For 16K-32K PET, Dual Disk, and Printer

FREE: LABEL PRINTER MODULE
FREE: REPORT GENERATOR MODULE
Specify CBM 2040 or COMPU/THINK

Package **$150** Introductory — **User's Guide** only **$25**
Demo Tape $5 Disk $ 8

Check or Money Order plus $2 Shipping
(NY residents add 8% Sales Tax)
- DEALER INQUIRIES WELCOMED -

JINI MICRO-SYSTEMS, Inc.
P.O. Box 274-B • Bronx, NY 10463

Circle 321 on inquiry card.

NOBLE COMPUTER CORPORATION
P.O. BOX 7035
PORTSMOUTH, VIRGINIA 23707
PHONE: (804)465-1814

Triple Buss Mother Board
With Triple Features

S-100 BUSS—S-50 BUSS—S-30 BUSS

Noble Computer Corporation announces the development of a combine triple buss mother board with the following features:

Built-In RS232/TTY Interface
Built-In 8 Bit Parallel Input/Output Interface
Built-In Audio Input/Output Interface for Data Communication

Also Available Computer Sound Board capable of producing **106,000,000 Distinct Sounds** for S-100 or S-50 Bus User complete with software, capable of producing 106 Million distinct sounds.

Also available — **S-50 INTERFACE**
Open up your computer system to the real world. Now at last there is an **S-50** to **S-100 Interface** available that allows you to be compatible with any S-100 Bus Interface system, I/O media or memory system. This third generation **S-50 Bus Interface** features:

- Selectable memory addressability
- Selectable I/O Device Addressability
- Up to 64K Addressability

Both products are assembled, tested and guaranteed:

Computer Sound Board — **$179.95**
S-50 to S-100 Interface — **$129.95**
Triple Buss Mother Board — **$149.95**

Disk Based Word Processor — 7.50

- A COMPLETE WORD PROCESSING SYSTEM FOR YOUR TRS-80
- PROVIDES FULL EDITING CAPABILITY INCLUDING PARAGRAPH MOVE, LINE DELETION, INSERTION AND CORRECTION.
- STORE TEXT ON DISK, PRINT BUSINESS/PERSONAL LETTERS, REPORTS WITH NUMBERED PAGES AND TITLE PAGES.
- TEXT IS STORED ON DISK AS BLOCKS ARE CREATED SO TEXTS ARE NOT LIMITED BY THE AVAILABLE MEMORY.
- REQUIRES 16K AND ONE OR MORE DISK DRIVES.
- COMES COMPLETE ON CASSETTE WITH SOFTWARE TO PRODUCE UPPER/LOWER CASE AT PRINTHEAD, AND KEYBOARD REVERSE.
- FULL RIGHT/LEFT JUSTIFICATION AND MUCH MORE
- SEND CHEQUE, MONEY ORDER OR ORDER BY PHONE, 24 HOURS, 7 DAYS A WEEK. MASTERCHARGE AND VISA CARDS WELCOME.
- PLEASE INCLUDE $1.00 EXTRA FOR FIRST CLASS POST

Available Now!

Mailing List Option — 7.50

- A COMPLETE MAILING LIST OPTION FOR THE OWNERS OF THE PENSA-WRITE WORD PROCESSOR.
- CAPACITY FOR 300 NAMES PER DISK.
- SORTS BY ZIP CODE, PRINTS BUSINESS LETTERS (CREATED BY PENSA-WRITE) AGAINST MAILING LIST OR PORTION THEREOF DEPENDING ON SELECTABLE CRITERIA.
- PRINTS LABELS IN USER DEFINABLE FORMAT: ANY NUMBER OF COLUMNS (UP TO 5) ACROSS THE PAGE, ANY TAB POSITIONS, AND ANY NUMBER OF SPACES BETWEEN ROWS.
- INTERFACES DIRECTLY WITH PENSA-WRITE SOFTWARE TO FORM THE COMPLETE WORD PROCESSING/MAILING SYSTEM.
- REQUIRES 32K AND ONE DISK DRIVE.
- PLEASE NOTE: PENSA-MAIL IS NOT A "STAND ALONE" PROGRAM AND IS DESIGNED TO BE USED WITH PENSA-WRITE.



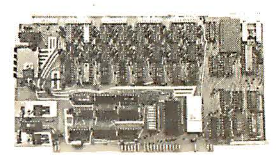
4441 West First Ave.
Vancouver, B.C.
V6R 4H9
604-224-3107





Circle 323 on inquiry card.

64 DAC S-100 Card!



only $529 Assm. & Tested

Features:

- 64 output channels from a single multiplexed 8-bit digital-to-analog converter (DAC)
- High density/Low cost: $8.30 per channel
- Compatible with any S-100 Bus system
- On board refresh saves the system's processor from the need to continually update each channel
- ±.4% absolute accuracy
- Options include: fast non-multiplexed 12-bit DAC and/or 10-bit digital output port
- Perfect for home, laboratory, or electronic music applications

Operations Manual — $5.00
Check or Money Order



Digital Multi-Media Control
2338 Patterson #12
Eugene, OR 97405

Circle 324 on inquiry card.

DAL - COMP

DAL-COMP gives you the finest lines in electronic hardware, components, computer boards and peripherals.

SD SYSTEMS
FOR S-100

Memory Boards, Video Boards, CPU Boards, PROM Boards, Single Board Computers, Controller Boards, Software.

SSM
FOR S-100 — APPLE

Video Boards, IO Boards, Music Boards, CPU Boards, RAM Boards, EPROM Boards, Extender Boards, Terminator Boards.

AP PRODUCTS

Solderless Plug Boards, Bread Boards, Flat Ribbon Cable Assemblies, Jumper Headers, Test Clips, Connectors, Sockets.

CALIF. COMPUTER SYSTEMS
FOR S-100 — APPLE — TRS 80

Interface Boards, PROM Boards, Controller Boards, CPU Boards, RAM Boards, Mainframes, Extender Boards, Proto Boards.

QT COMPUTER SYSTEMS
FOR S-100

Memory Boards, CPU Boards, Clock Calendar, Motherboards, I/O Boards, Video Boards, EPROM Boards, Controller Boards.

MOUNTAIN HARDWARE
FOR APPLE

Introl X-10, Apple Clock, Super Talker, ROM Writer, ROM Plus, Music System, A/D & D/A, Expansion Chassis.

— PANAVISE — OK MACHINE & TOOL — MODEMS — EPROM ERASERS — DISKS — DISK DRIVES — POWER SUPPLIES — VECTOR ELECTRONICS — IC's — (TTL — CMOS — MEMORY) — SOCKETS — SWITCHES — TERMINALS —

BEFORE YOU BUY

Call Dal-Comp for prices on all your electronic and computing needs. We offer the finest products in the industry at prices you can compare with anyone. Check our fast service and responsive sales people.

CALL TOLL FREE 800-527-5310 • TEXAS RESIDENTS CALL COLLECT (214) 350-6898

THIS MONTH'S SPECIAL

SALE PRICES ARE FOR PREPAID ORDERS ONLY.
FOR OPEN ACCOUNT PLEASE CALL FOR PRICING & TERMS.

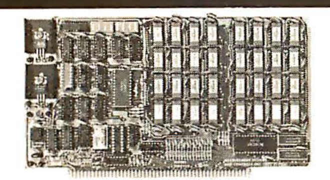
4116 250NS	8/$47.95	8279-5	18.50	DB25P Male Plug	2.95
2708 450NS	6.25	2114L 300NS	4.95	DB25S Fem. Socket	3.60
2716	19.95	1771	26.95	DB25C Cover	1.50
TMS2716 +5, −5, +12	17.00	1791	37.95	RS232 Set/1ea of above	6.50
2732	79.95	1863/AY5 1015	5.95	UV Eraser	68.95
8080A	3.50	1602B UART	3.95	Dip Switches	Call
Z80A	13.95	S-2350 USRT	7.95	Zip Dip Sockets	Call
8253-5	20.25	8212	3.50	Lo-Pro Sockets	Call



TERMS OF SALE: Cash, checks, money orders, VISA, Master Charge. Minimum Order $10.00. Texas residents add 5% sales tax. Minimum shipping and handling charge $3.00. COD orders add $2.00 COD fee. U.S. funds only. PRICES SUBJECT TO CHANGE WITHOUT NOTICE. SOME ITEMS SUBJECT TO PRIOR SALE. WE RESERVE THE RIGHT TO LIMIT QUANTITIES. 90 DAY GUARANTEE.

DAL-COMP M/O DIV. 2560 ELECTRONIC LANE, SUITE 108, DALLAS, TEXAS 75220 • (214) 350-6895

Circle 325 on inquiry card.



64K BYTE EXPANDABLE RAM

DYNAMIC RAM WITH ON BOARD TRANSPARENT REFRESH GUARANTEED TO OPERATE IN NORTHSTAR, CROMEMCO, VECTOR GRAPHICS, SOL, AND OTHER 8080 OR Z-80 BASED S100 SYSTEMS ★ 4MHZ Z-80 WITH NO WAITSTATES.

- ★ SELECTABLE AND DESELECTABLE IN 4K INCREMENTS ON 4K ADDRESS BOUNDARIES.
- ★ LOW POWER—8 WATTS MAXIMUM.
- ★ 200NSEC 4116 RAMS.
- ★ FULL DOCUMENTATION.
- ★ ASSEMBLED AND TESTED BOARDS ARE GUARANTEED FOR ONE YEAR AND PURCHASE PRICE IS FULLY REFUNDABLE IF BOARD IS RETURNED UNDAMAGED WITHIN 14 DAYS.

	ASSEMBLED / TESTED
64K RAM	$595.00
48K RAM	$529.00
32K RAM	$459.00
16K RAM	$389.00



S100 MAINFRAME AND CARD CAGE

- ★ W/ SOLID FRONT PANEL . . $239.00
- ★ W/ CUTOUTS FOR 2 MINI—FLOPPIES . . . $239.00
- ★ 30 AMP POWER SUPPLY $119.00
- ★ 8 SLOT MOTHERBOARD $149.00
- ★ 19 SLOT MOTHERBOARD $199.00

16K MEMORY EXPANSION KIT

ONLY $58

FOR APPLE, TRS-80 KEYBOARD, EXIDY, AND ALL OTHER 16K DYNAMIC SYSTEMS USING MK4116-3 OR EQUIVALENT DEVICES.

- ★ 200 NSEC ACCESS, 375 NSEC CYCLE
- ★ BURNED-IN AND FULLY TESTED
- ★ 1 YR. PARTS REPLACEMENT GUARANTEE
- ★ QTY. DISCOUNTS AVAILABLE



VISTA V-200 MINI-FLOPPY SYSTEM

- ★ S100 DOUBLE DENSITY CONTROLLER
- ★ 204 KBYTE CAPACITY FLOPPY DISK DRIVE WITH CASE & POWER SUPPLY
- ★ MODIFIED CPM OPERATING SYSTEM WITH EXTENDED BASIC

$695.00



1230 W. COLLINS AVE.
ORANGE, CA 92668
(714) 633-7280

Calif. residents please add 6% sales tax. Mastercharge & Visa accepted. Please allow 14 days for checks to clear bank. Phone orders welcome. Shipping charges will be added to all shipments.

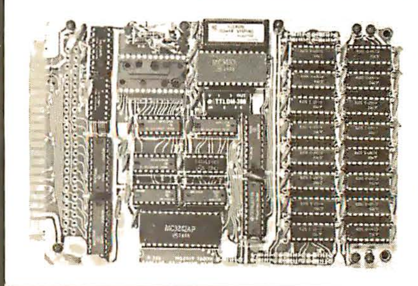
32K BYTE MEMORY

RELIABLE/COST EFFECTIVE EXPANDABLE RAM FOR 6502 AND 6800 SYSTEM—AIM 65·*KIM*SYM*PET*S44-BUS

- ★ PLUG COMPATIBLE WITH THE AIM-65/SYM EXPANSION CONNECTOR BY USING A RIGHT ANGLE CONNECTOR (SUPPLIED) MOUNTED ON THE BACK OF THE MEMORY BOARD.
- ★ MEMORY BOARD EDGE CONNECTOR PLUGS INTO THE 6800 S 44 BUS.
- ★ CONNECTS TO PET OR KIM USING AN ADAPTOR CABLE.
- ★ RELIABLE—DYNAMIC RAM WITH ON BOARD INVISIBLE REFRESH—LOOKS LIKE STATIC MEMORY BUT AT LOWER COST AND A FRACTION OF THE POWER REQUIRED FOR STATIC BOARDS.
- ★ USES +5V ONLY, SUPPLIED FROM HOST COMPUTER.
- ★ FULL DOCUMENTATION, ASSEMBLED AND TESTED BOARDS ARE GUARANTEED FOR ONE YEAR AND PURCHASE PRICE IS FULLY REFUNDABLE IF BOARD IS RETURNED UNDAMAGED WITHIN 14 DAYS.

ASSEMBLED & TESTED
- WITH 32K RAM $419.00
- WITH 16K RAM $349.00
- WITHOUT RAM CHIPS $279.00

HARD TO GET PARTS (NO RAM CHIPS) WITH BOARD AND MANUAL $109.00
BARE BOARD & MANUAL $49.00



PET INTERFACE KIT—CONNECTS THE 32K RAM BOARD TO A 4K OR 8K PET. CONTAINS: INTERFACE CABLE, BOARD STANDOFFS, POWER SUPPLY MODIFICATION KIT AND COMPLETE INSTRUCTIONS. $49.00

U.S. PRICES ONLY

C/MOS (DIODE CLAMPED)

4001	.35	4027	.45	4081	.35	74C74	.50
4002	.35	4028	.80	4082	.32	74C76	.70
4006	1.10	4029	.95	4093	.95	74C83	1.30
4007	.27	4030	.35	4501	.95	74C85	1.40
4009	.45	4034	2.25	4510	.90	74C83	1.30
4010	.45	4035	.97	4511	.95	74C85	1.40
4011	.35	4040	1.00	4514	1.95	74C86	.50
4012	.35	4042	.85	4515	1.95	74C93	.95
4013	.40	4043	1.00	4516	1.00	74C151	1.75
4014	1.20	4044	.90	4518	1.20	74C157	1.75
4015	1.00	4046	1.95	4520	1.00	74C160	1.20
4016	.45	4049	.75	74C00	.27	74C161	1.15
4017	1.05	4050	.45	74C02	.27	74C163	1.15
4018	.90	4051	1.10	74C04	.40	74C165	1.25
4019	.45	4052	1.10	74C08	.30	74C173	1.30
4020	1.10	4053	1.10	74C10	.27	74C174	1.20
4021	1.10	4066	.70	74C14	1.20	74C175	1.20
4022	1.00	4069	.45	C20	.27	74C192	1.30
4023	.35	4071	.35	74C32	.45	74C901	.50
4024	.75	4072	.35	74C42	.90	74C926	6.95
4025	.35	4076	1.00	74C73	.75		

1488 RS232 INTERFACE —	$1.40	AMD 2901BDC HISPEED BIT SLICER —	$13.95
1489 RS232 INTERFACE —	1.25	TMS 4045-25 — 1K × 4 250NS STATIC RAM —	6.70
2509 TRI STATESTAT.SR —	1.35	82S23 —	2.95
2522 STATIC SHIFT REG. —	1.95	82S115 —	6.95
2708 8K EPROM (450ns) —	8.95	82S123 —	4.95
TMS 3409 NC80BITSDYN.S.R.	1.35	82S129 —	3.25
2716 (TI) 3 VOLTAGES —	16.95	82S126 —	2.95
2716 (Intel) + 5V —	26.95	82S131 —	3.95
2114 4K STAT. RAM (450 ns) —	4.50	82S130 —	3.45
2532 4K × 8EPROM —	69.00	AY51013 UART —	3.75
2102-1 (450ns) —	.90	TRI 6028 —	4.25
21L02-3 (350 ns) —	.99	MC6845 —	24.95
MM5270 4K X 1 DYN. —	3.45	MCM 6571A 7 × 9 Char. gen —	10.75
MK4008P —	1.95	MMM5321-TVSYNC GEN. —	9.75
2101-1 254 × 4 STATIC —	2.45	8080A —	7.75
FD1791 FLOPPY DISC CONTROLLER —	34.95	8205 —	3.95
MK4027-3 4K · 1 DYN. (200 ns)	3.95	8216 —	2.90
MK4096 11K · 1 DYN.RAM. —	2.95	8223 —	4.95
4116 3 16K DYN. 300 NS —	5.50	8255.5 —	5.95
5280/2107B 4K DYN. RAM —	3.40	8251 —	6.95
TMS 4050L —	3.95		

8130	2.95	8T380	2.25	8837	2.25
8131	2.95	8830	2.95	8838	2.25
8833	2.50	8834	2.25		

DATEL'S DAC-08BC — 8 bit DAC — $9.95

8" DISKETTES — HARD SECTOR
$1.75, 10/$16.00

CRYSTALS $3.45 ea.

2.000 MHz	6.144 MHz
4.000 MHz	8.000MHz
3.000 MHz	10.000 MHz
3.57 MHz	18.000 MHz
5.000 MHz	20.000 MHz
6.000 MHz	

RIBBON CABLE FLAT (COLOR CODED) #30 WIRE
- 16 cond. - .40/per foot
- 40 cond. - .75/per foot
- 50 cond. - .90/per foot

RS232 CONNECTORS
- DB 25P male $3.25
- DB 25S female . . . $4.25
- HOODS $1.50

200PRV 1A LASER .95

LED READOUTS

FCS 8024 - 4 digit C.C. 8" display	$5.95	DL-707 C.A. .3"	$ .75
FND 503 C.C. .5"	$ .85	DL 747 C.A. .6"	$1.50
FND 510 C.A. .5"	$ .85	HP3400 .8" CA	$1.95
DL-704-.3" C.C.	$ .85	HP3405 .8" CC	$1.95

PRINTED CIRCUIT BOARD

4" x 6" DOUBLE SIDED EPOXY BOARD 1/16" thick $.60 ea. . . . . 5/$2.60

EPOXY glass vector board 1/16" thick with 1/10" spacing 4½" x 6½" $1.95

74S00	.30	74S20	.40	74S153	1.10
74S02	.30	74S30	.40	74S151	1.25
74S05	.45	74S32	.40	74S157	1.25
74S08	.40	74S89	1.90	74S158	1.25
74S11	.35	74S112	.85	74S174	1.40
74S15	.40	74S140	1.00	74S257	1.50

7 WATT LD-65 LASER DIODE IR $8.95

25 watt Infra Red Pulse (SG 2006 equiv.) Laser Diode (Spec sheet included) $24.95

MINIATURE MULTI-TURN TRIM POTS
100, 5K, 10K, 20K, 250K, 1 Meg, $.75 each . . . 3/2.00

- 2N3820 P FET . . . . $ .45
- 2N 5457 N FET . . . . $ .45
- 2N2646 UJT . . . . $ .45
- ER 900 TRIGGER DIODES . . . . 4/$1.00
- 2N 6028 PROG. UJT . . . . $ .65

- FP 100 PHOTO TRANS . . . . $ .50
- RED, YELLOW OR GEEN LARGE LED's. 2" . . . . . 6/$1.00
- RED/GREEN BIPOLAR LED's. . . . . $ .55
- MLED92 R LED . . . . $ .75
- MRD14B PHOTO DARL. XTOR . . . . $ .75
- TIL-118 OPTO-ISOLATOR . . . . $ .75
- IL-5 OPTO-ISOLATOR . . . . $ .80
- 1 WATT ZENERS: 3.3, 4.7, 5.1, 5.6, 6.8, 8.2, 9.1, 10, 12, 15, 18, or 22V . . . . 6/$1.00

TTL REED RELAY — SPST 5V 20ma $1.00

Silicon Power Rectifiers

PRV	1A	3A	12A	50A	125A	240A
100	.06	.14	.35	.90	.3.70	5.00
200	.07	.20	.40	1.30	4.25	6.50
400	.09	.25	.65	1.50	6.50	9.60
600	.11	.30	.80	2.00	8.50	12.50
800	.15	.35	1.00	2.50	10.50	16.50
1000	.20	.45	1.25	3.00	12.50	20.00

- IN 4148 (IN914) . . . . 15/$1.00
- .1 or .01 uf 25V ceramic disc. caps. 16/$1.00, 100/$50.00

REGULATORS

- LM317T $2.50
- 323K - 5V 3A $5.75
- 79HGKC - 5V at 5A . . . $6.95
- 723 . . . . $ .50
- 320T - 5, 12, or 15V $1.10
- LM305H 75
- 340K - 12, 15 or 24 V $1.50
- 340T - 5, 6, 8, 12, 15, 18 or 24 V $1.10
- 320M5 . . . . $ .75

TRANSISTOR SPECIALS

- 2N1303 PNP GE TO-5 . . . . 3/$1.00
- 2N1307 PNP GE TO-5 . . . . $ .40
- 2N404A PNP GE TO-5 . . . . 3/$1.00
- 2N1546 PNP GE TO-3 . . . . $ .95
- 2N6233 NPN SWITCHING POWER $1.95
- MRF-8004 a CB RF TRANSISTOR NPN . . . . $ .75
- 2N3772 NPN Si TO-3 . . . . $1.00
- 2N4908 PNP Si TO-3 . . . . $1.00
- 2N5086 PNP Si TO-92 . . . . 4/$1.00
- 2N3137 NPN Si RF . . . . $ .55
- 2N3919 NPN Si TO-3RF $1.50
- 2N1420 NPN Si TO-5 . . . . 3/$1.00
- 2N3767 NPN Si TO-66 . . . . $ .70
- 2N2222 NPN Si TO-18 . . . . 5/$1.00
- 2N3055 NPN Si TO-3 . . . . $ .60
- 2N3904 NPN Si TO-92 . . . . 6/$1.00
- 2N3906 PNP Si TO-92 . . . . 6/$1.00
- 2N5296 NPN Si TO-220 . . . . $ .55
- 2N6109 PNP Si TO-220 . . . . $ .55
- 2N1309 PNP 6B TO-5 . . . . $ .40
- TIP 31B NPN Si TO-220 . . . . $ .60
- TIP 32B PNP Si TO-220 . . . . $ .65
- 2N5641 NPN 1A RF POWER $2.50

TTL IC SERIES

7400	.17	7448	.75	74157	.65
74101	.17	7450	.17	74160	.85
7402	.17	7472	.35	74161	.80
7403	.17	7473	.35	74162	1.20
7404	.24	7474	.42	74163	.95
7405	.24	7475	.49	74164	.85
7406	.33	7476	.45	74165	.85
7407	.35	7480	.45	74166	1.05
7408	.27	7483	.60	74167	1.35
7409	.24	7485	.75	74170	1.60
7410	.17	7486	.42	74173	1.30
7411	.22	7489	1.60	74174	.85
7412	.22	7490	.50	74175	.75
7413	.42	7491	.55	74176	.75
7414	.90	7492	.50	74177	.75
7416	.33	7493	.50	74180	.75
7417	.37	7494	.60	74181	1.90
7420	.17	7495	.60	74190	1.20
7425	.35	7496	.60	74191	1.20
7426	.33	74107	.35	74192	.79
7427	.35	74121	.35	74193	.79
7430	.17	74122	.39	74194	.85
7432	.27	74123	.42	74195	.65
7437	.27	74125	.45	74196	.85
7438	.27	74126	.45	74197	.87
7440	.17	74145	.75	74279	.95
7441	.85	74150	1.10	74325	2.25
7442	.50	74151	.65	74365	.80
7445	.70	74153	.55	74367	.80
7446	.75	75154	1.10	74368	.65
7447	.75	74155	.75	75491	1.05
				75492	1.05
				8T98	1.10

14 pin headers 3/$1.00

- MM5387AA . . . . . . CLOCK CHIPS $5.95
- MM5314 . . . . $4.75
- MM5316 . . . . $4.95

NO. 30 WIRE WRAP WIRE SINGLE STRAND 100' $1.40

ALCO MINIATURE TOGGLE SWITCHES
- MTA 106 SPDT $1.05
- MTA 206 DPDT $1.70
- MTA 206 P-DPDT CENTR OFF $1.85
- MSD 206 P-DPDT CENTER OFF LEVER SWITCH $1.85

Full Wave Bridges

PRV	2A	6A	25A
100			1.40
200	.80	1.30	2.20
400	1.00	1.65	3.30
600	1.30	1.90	4.40

DIP SOCKETS

8 PIN	.17	22 PIN	.30
14 PIN	.20	24 PIN	.35
16 PIN	.22	28 PIN	.40
18 PIN	.25	40 PIN	.60

SANKEN AUDIO POWER AMPS
- Si 1010 G 10 WATTS . . . . $ 7.50
- Si 1020 G 20 WATTS $13.75
- Si 1050 G 50 WATTS $26.90

TANTULUM CAPACITORS

.22UF 35 V	5/$1.00	4.7UF 15V	5/$1.00
.47UF 35 V	5/$1.00	6.8UF35V	4/$1.00
.68UF 35 V	5/$1.00	15UF16V	3/$1.00
1UF 35V	5/$1.00	30UF6V	5/$1.00
2.2UF 20V	5½$1.00	33UF20V	$ .60
3.3UF 20V	4/$1.00	100UF 15V	$ .70
		150UF 15V	$ .95

74LS SERIES

74LS00	.28	74LS153	1.19
74LS01	.29	74LS155	1.19
74LS02	.28	74LS156	1.19
74LS03	.28	74LS157	.85
74LS04	.35	74LS160	1.10
74LS05	.35	74LS162	1.10
74LS08	.35	74LS163	1.20
74LS09	.35	74LS164	1.20
74LS10	.30	74LS168	1.25
74LS11	.45	74LS169	1.25
74LS12	.35	74LS170	1.70
74LS13	.95	74LS173	1.30
74LS14	1.20	74LS174	1.00
74LS15	.35	74LS175	1.00
74LS20	.30	74LS181	2.50
74LS21	.55	74LS190	1.25
74LS22	.35	74LS191	1.15
74LS26	.35	74LS192	1.00
74LS27	.45	74LS193	1.10
74LS28	.45	74LS194	1.95
74LS30	.35	74LS195	1.10
74LS32	.40	74LS196	1.20
74LS37	.45	74LS197	1.10
74LS38	.55	74LS240	2.50
74LS40	.40	74LS241	2.95
74LS42	1.00	74LS242	3.00
74LS47	1.05	74LS243	2.75
74LS51	.35	74LS244	2.50
74LS54	.35	74LS251	1.29
74LS74	1.05	74LS257	.90
74LS76	.45	74LS258	1.50
74LS86	.45	74LS259	1.50
74LS90	.90	74LS266	.70
74LS92	.90	74LS279	.70
74LS93	.90	74LS290	.80
74LS107	.45	74LS293	.80
74LS109	.45	74LS295	1.50
74LS112	.45	74LS298	1.50
74LS113	.45	74LS365	.80
74LS114	.55	74LS366	.80
74LS125	.90	74LS367	.80
74LS126	.90	74LS368	.80
74LS132	.95	74LS375	.95
74LS138	1.25	74LS377	2.75
74LS139	1.30	74LS386	.50
74LS151	1.19	74LS390	1.95

LINEAR CIRCUITS

LM201	.75
LM270	1.50
LM301/748	.25
LM307	.30
LM 8	.75
LM311	.75
LM318	1.20
LM324	.95
LM339	1.10
LM348	.90
LM358	.70
LM361	1.75
LM377	1.60
LM380	.95
LM382	1.25
LM386	.80
LM387	1.25
LM1808	1.75
1810PC	2.20
LM1889	1.95
CA3018	1.95
CA3080	.95
CA3086	.95
LM370	1.50
LM537	2.50
LM553	2.50
LM565	.49
LM566	.85
560	2.00
565	.95
566	1.25
567	1.10
702	.95
703	.85
709	.25
710	.45
711CH	.40
741C or V	.30
747	.50
LM1310	1.95
1458	.50
3900	.55
8038CC	3.90
4136	.95
LF356	1.25
NE540L	2.50

SCR'S

	1.5A	6A	35A	110A
100	.45	.60	1.40	
200	.70	.80	1.90	9.00
400	1.20	1.40	2.60	12.00
600		1.80	3.60	15.00

TRIACS

PRV	1A	10A	25A
100	.45	.80	1.55
200	.84	1.30	2.10
400	1.30	1.90	3.10
600	2.00	2.75	4.30

Terms: FOB Cambridge, Mass
Send Check or Money Order
Include Postage, Minimum
Telephone, C.O.D. Purchase
Order or Charge $20.00.
Minimum Mail Order $5.00.

Send 25¢ for our catalog featuring Transistors and Rectifiers
145 Hampshire St., Cambridge, Mass.



SOLID STATE SALES
P.O. BOX 74B
SOMERVILLE, MASS. 02143 TEL. (617) 547-7053

WE SHIP OVER 95% OF OUR ORDERS THE DAY WE RECEIVE THEM

Circle 326 on inquiry card.

WE WILL NOT BE UNDERSOLD

16K MEMORY UPGRADE KITS $49

for TRS-80*, Apple II, (specify): **Jumpers $2.50**

PRINTERS

NEC Spinwriter



Letter Quality High Speed Printer
Includes TRS-80* interface software, quick change print fonts, 55 cps, bidirectional, high resolution plotting, graphing, proportional spacing: R.O. **$2689**

R.O. with Tractor Feed **$2789** KSR with Tractor Feed **$3200**

779 CENTRONICS TRACTOR FEED PRINTER **$969**
Same as Radio Shack line printer I

737 CENTRONICS FRICTION & PIN FEED PRINTER **$839**
9 x 7 matrix

730 CENTRONICS FRICTION & PIN FEED PRINTER **$639**
7 x 7 matrix Same as Radio Shack line printer II

P1 CENTRONICS PRINTER **$269**
Same as Radio Shack quick printer

PAPER TIGER (IP440) **$939**
Includes 2K buffer and graphics option

TI-810 Faster than Radio Shack line printer III
Parallel and serial w/TRS-80* interface software **$1575**
with upper and lower case and paper tray **$1665**

OKIDATA Microline 80 Friction and pin feed **$559**
Tractor Feed, friction, and pin feed **$679**

EATON LRC 7000 + 64 columns, plain paper **$349**

ANADEX **DP-9500** **$1389** **DP-8000** **$869**

DISK OPERATING SYSTEMS

PATCHPAK #4 by Percom Data **$ 8.95**

CP/M for Model I, Zenith **$145** • for Model II, Altos **$169.00**

NEWDOS Plus — with over 200 modifications 35track **$ 89.00**
and corrections to TRS-DOS 40 or 70 Track **$ 99.00**

DISK DRIVES $314

More capacity than Radio Shack 35 Track (80 K Bytes) drives. Fully assembled and tested. Ready to plug-in and run the moment you receive it. Can be intermixed with each other and Radio Shack drive on same cable. TRS-80* compatible silver enclosure. **External card edge included.**

90 DAY WARRANTY. ONE YEAR ON POWER SUPPLY.

FOR TRS-80*

CCI-100	5¼", 40 Track (102K Bytes) for Model I	**$314**
CCI-200	5¼", 77 Track (197K Bytes) for Model I	**$549**
CCI-800	8" Drive for Model II (½ Meg Bytes)	**$795**
For Zenith Z89		
CCI-189	5¼", 40 Track (102K Bytes) add-on drive	**$394**
Z-87	Dual 5¼" add-on drive system	**$995**

DISKETTES — Box of 10 (5¼") - with plastic library case **$24.95**
8" double density for Model II (box of 10) **$36.49**

COMPLETE SYSTEMS

TRS-80* LEVEL II-16K with keypad	**$709**
TRS-80* Expansion Interface	**$269**
HEWLETT PACKARD HP-85	**$3199**
ZENITH Z89, 48K all-in-one computer	**$2595**
ZENITH Z19	**$740**
TELEVIDEO 912B **$745**	920B **$769**
ATARI 400 $489	**ATARI 800 $799**
MATTEL INTELLIVISION	**$249**

Software available for the above systems

CAT MODEM Originate and answer same as Radio Shack Telephone Interface II **$148**

LEEDEX MONITOR Video 100 **$119**

SOFTWARE FOR THE TRS-80* Software w/Manual / Manual Alone

CCI-INVESTMENT PORTFOLIO MANAGER: This is what investors have been waiting for! This powerful program was developed by security analysts working with software designers. It comes on one cassette — 16K LEVEL II BASIC on one side, 32K DISK BASIC on the other. Store and report data; Review your portfolio; Produce detailed status, value, gain, and security analysis; Compare alternatives **$49.95/$10**

INTELLIGENT TERMINAL SYSTEM ST-80-III BY LANCE MIKLUS: Enables a TRS-80* to act as a dial-up terminal on any standard time sharing network. Provides a TRS-80* with control key, ESC Key, Repeat Key, Rub Out Key, Break Key, full upper and lower case support, selectable printer output and program selectable transmission rates **$139/$10**

CCA-DATA MANAGEMENT SYSTEM: Automate your information processing tasks. You can create a file of customer information; quickly and easily add, delete or update records; search a file; keep a file in order of the value in any field; and print records and labels in any desired sequence or from just a part of a file. Requires 32K TRS-80 and one drive. **$74.95/$10**

CSA-MAILIST SYSTEM: Creates, maintains and efficiently utilizes a name, address and telephone number file. 400 individual name/address entries can be maintained on a single density mini-floppy, and are manipulated directly by record number (direct access file method). Sorts can be performed, name + address combinations can be coded. Listing-directories and labels can be printed. A conversion facility is provided to convert most sequential name, address file formats into direct. Requires 32K TRS-80 and one drive. **$49.95/$10**

S & M SYSTEMS
INSEQ-80™: Indexed Sequential Access Method (ISAM) for the TRS-80 Model I. A must for anyone writing business programs. Eliminate wasted disk space from direct record processing. Split second access to any record. Access data records instantly via alpha/numeric "key" eg. Part NR, zip code or sequentially in ascending key sequence. Add/modify records in any order. Access up to three files per program—Files may be spread over multiple disks. Machine language processing from your basic program. Utility program to convert direct files to INSEQ-80 format. **$49.95/$10**

FULLY INTERACTIVE ACCOUNTING PACKAGE: ISAM (INSEQ-80) based. Includes General Ledger, Accounts Payable, Accounts Receivable and Payroll. System runs "stand alone" or "co-ordinated G/L" at users option. Based on Osborne accounting method. Requires 32K, TRS-80, 2 or 3 drives. N/A CA.

General Ledger	**$99/$10**
Accounts Receivable	**$99/$10**
Accounts Payable	**$99/$10**
Payroll	**$99/$10**

Osborne books: Req'd as additional documentation $20 ea

INVENTORY Requires 32K, TRS-80, 1 drive **$125/$10**

INSORT-80: Callable form BASIC via USR. Sorts "Random" Disk Files. "Disk" to "Disk" sort times—350 records in 35 secs, 1000 records in 6 minutes, 3500 records in 12 minutes. Machine language processing. Up to 35 sort keys ascending/descending. Utility to build BASIC program. Runs under NEWDOS. **$49.95/$10**

CP/M BASED SOFTWARE for Zenith, Altos, Radio Shack, Apple Software w/Manual / Manual Alone

MICROSOFT
BASIC-80: Disk Extended BASIC ANSI compatible with long variable names, WHILE/WEND, chaining, variable length file records. **$325/$25**

BASIC COMPILER: Language compatible with BASIC-80 and 3-10 times faster execution. Produces standard Microsoft relocatable binary output. Includes MACRO-80 Also linkable to FORTRAN-80 or COBOL-80 code modules. **$350/$25**

FORTRAN-80: ANSI 66 (except for COMPLEX) plus many extensions. Includes relocatable object compiler, linking loader, library with manager. Also includes MACRO-80(see below) **$425/$25**

COBAL-80: Level 1 ANSI '74 standard COBAL plus most of Level 2. Full sequential, relative and indexed file support with variable file names. STRING, UNSTRING, COMPUTE, VARYING/UNTIL, EXTEND, CALL, COPY, SEARCH, 3-dimensional arrays, compound and abbreviated conditions, nested IF. Powerful interactive screen-handling extensions. Includes compatible assembler, linking loader, and relocatable library manager as described under MACRO-80. **$700/$25**

Z-80 SOFTCARD FOR APPLE: Your key to future software expansion. Get the best of both worlds, Apple's 6502 and CP/M Z-80. Plug in the card and get a Z80. Supports Apple language card and all Apple peripherals. Comes with set of three manuals. **$339/$75**

CCI-TELNET VERSION 5: A communication Package which enables microcomputer users to communicate both with Large Mainframes and other microcomputers. Extensive commands make it useful in many applications where communication between computers is necessary. Powerful terminal mode enabling user to save all data from a session on disk. Completely CP/M compatible. Multiple communication protocols supported. Able to transfer files in both directions without protocol where the other machine does not support any protocol. Extensive ON-SCREEN help. Sourcecode provided. **$149/$15**

MICROPRO-WORD-STAR: Menu driven visual word processing system for use with standard terminals. Text formatting performed on screen. Facilities for text paginate, page number, justify, center and underscore. User can print one document while simultaneously editing a second. Edit facilities include global search and replace. Read/Write to other text files, block move, etc. Requires CRT terminal with addressable cursor positioning. **$399/$40**

BDS 'C' COMPILER: Supports most features of language, including structures, arrays, pointers, recursive function evaluation, and overlays. Package contains: compiler, linker, library manager; sample source files include games, a terminal emulator with disk I/O plus the source for many standard library functions; BDS C User's Guide; Book - The C Programming Language by Dennis Ritchie and Brian Kernigham. Requires at least 24K of RAM **$125/$20**

CONFIGURABLE BUSINESS SYSTEM BY DMA: CBS is a data management system that allows true transaction processing. The system features a screen menu generator and a comprehensive report generator which can be used to produce invoices, purchase orders, re-order reports, mailing labels or other special reports specific to the application. Good documentation and a demonstration inventory system supplied. Requires at least 48K memory. Does not require any support language. **$295**

ACCESSORIES

HEAD CLEANING DISKETTE: Cleans drive Read/Write head in 30 seconds. Diskette absorbs loose oxide particles, fingerprints, and other foreign particles that might hinder the performance of the drive head. Lasts at least 3 months with daily use. Specify 5¼" or 8". **$20 ea/$45 for 3**

FLOPPY SAVER: Protection for center holes of 5¼" floppy disks. Only 1 needed per diskette. Kit contains centering post, pressure tool, tough 7-mil mylar reinforcing rings. Installation tools and rings for 25 diskettes. **$11.95**
Re-orders of rings only: **$ 7.95**

ACCESSORIES

EXTERNAL DATA SEPARATOR: Eliminates data separation problems(crc). Improves reliability. This plug-in unit comes fully assembled and tested. **$29.95**
RS 232 **$89.00**

DISK-DRIVE EXTENDER CABLES: Fits all mini-disk drives. **$15.95**

AC LINE CORD FILTER & 6 PRONG POWER STRIP **$39.00**
DISK DRIVE CABLES: 2 drive-**$29.00** 4 drive-**$35.00**
DUST COVERS: TRS-80/Apple. **$ 7.95**
TRS-80 & OTHER MYSTERIES **$19.95**
RF MODULATOR: Adapts video to TV. **$35.00**

DEALER (NATIONAL/INTERNATIONAL) INQUIRIES INVITED **Send for FREE Catalogue**

The CPU SHOP

TO ORDER CALL TOLL FREE 1-800-343-6522
Massachusetts residents call **(617) 242-3361**
For detailed technical information, call 617/242-3361
Hours: 10AM-6PM (EST) M-F (Sat. till 5)
*TRS-80 is a Tandy Corporation Trademark

5 Dexter Row, Dept. **B9**M
Charlestown, Massachusetts 02129

Massachusetts residents add 5% sales tax

Quantities on some items are limited

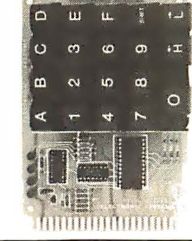




Circle 328 on inquiry card.

Circle 329 on inquiry card.

HEX ENCODED KEYBOARD



Four onboard LEOs indicate the HEX code generated for each key depression. The board requires a single +5 volt supply. Board only $15.00 Part No. HEX-3, with parts $49.95 Part No. HEX- 3A. 44 pin edge connector $4.00 Part No. 44P.

ASCII TO CORRESPONDENCE CODE CONVERTER

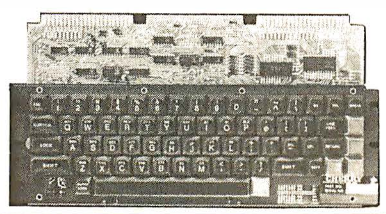
This bidirectional board is a direct replacement for the board inside the Trendata 1000 terminal. The on board connector provides RS-232 serial in and out. Sold only as an assembled and tested unit for $249.95. Part No. TA 1000C

ASCII KEYBOARD

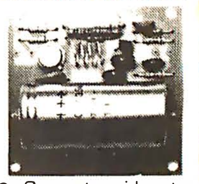
53 Keys popular ASR-33 format • Rugged G-10 P.C. Board • Tri-mode MOS encoding • Two-Key Rollover • MOS/DTL/TTL Compatible • Upper Case lockout • Data and Strobe inversion option • Three User Definable Keys • Low contact bounce • Selectable Parity • Custom Keycaps • George Risk Model 753. Requires +5, -12 volts. $59.95 Kit.

ASCII KEYBOARD

TTL & DTL compatible • Full 67 key array • Full 128 character ASCII output • Positive logic with outputs resting low • Data Strobe • Five user-definable spare keys • Standard 22 pin dual card edge connector • Requires +5VDC, 325 mA. Assembled & Tested. Cherry Pro Part No. P70-05AB. $119.95.



T.V. INTERFACE



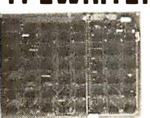
• Converts video to AM modulated RF, Channels 2 or 3. So powerful almost no tuning is required. On board regulated power supply makes this extremely stable. Rated very highly in Doctor Dobbs' Journal. Recommended by Apple • Power required is 12 volts AC C.T., or +5 volts DC • Board only $7.60 part No. 107, with parts $13.50 Part No. 107A

TAPE INTERFACE



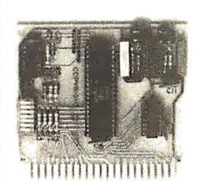
• Converts a low cost tape recorder to a digital recorder • Works up to 1200 baud • Digital in and out are TTL-serial • Output of board connects to mic. in of recorder • Earphone of recorder connects to input on board • No coils • Requires +5 volts, low power drain • Board only $7.60 Part No. 111, with parts $29.95 Part No. 111A

T.V. TYPEWRITER



• Stand alone TVT • 32 char/line, 16 lines, modifications for 64 char/line included • Parallel ASCII (TTL) input • Video output • 1K on board memory • Output for computer controlled curser • Auto scroll • Non-destructive curser • Curser inputs: up, down, left, right, home, EOL, EOS • Scroll up, down • Requires +5 volts at 1.5 amps, and -12 volts at 30 mA • All 7400, TTL chips • Char. gen. 2513 • Upper case only • Board only $39.00 Part No. 106, with parts $145.00 Part No. 106A

UART & BAUD RATE GENERATOR



• Converts serial to parallel and parallel to serial • Low cost on board baud rate generator • Baud rates: 110, 150, 300, 600, 1200, and 2400 • Low power drain +5 volts and -12 volts required • TTL compatible • All characters contain a start bit, 5 to 8 data bits, 1 or 2 stop bits, and either odd or even parity. • All connections go to a 44 pin gold plated edge connector • Board only $12.00 Part No. 101, with parts $35.00 Part No. 101A, 44 pin edge connector $4.00 Part No. 44P

SOROC IQ 120



Upper/lower case display • Numeric keypad & cursor keys • Protected fields, ½ intensity display • RS 232 interface & aux. port. IQ120—$799.95 • IQ140 Detachable keyboard—$1199.95

MODEM



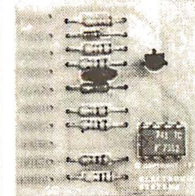
• Type 103 • Full or half duplex • Works up to 300 baud • Originate or Answer • Serial TTL input and output • connect 8 Ω speaker and crystal mic. directly to board • Requires +5 volts • Board only $7.60 Part No. 109, with parts $29.95 Part No. 109A.

A-to-D D-to-A CONVERTER



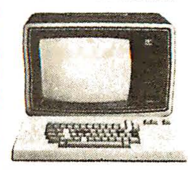
Analog to Digital, Digital to Analog Converter, A-D conversion time 20us. D-A conversion 5us. Uses include speech and music synthesizing and slow scan TV. Single power supply (5V), 8 Bits wide, latched I/O, strobe lines. Part No. 79287K Complete Kit $49.95 • Part No. 79287A Assembled $69.95

RS-32/TTL INTERFACE



• Converts TTL to RS-232, and converts RS-232 to TTL • Two separate circuits • Requires -12 and +12 volts • All connections go to a 10 pin edge connector, kit $9.95 Part No. 232A 10 Pin edge connector $3.00 part No. 10P.

COMPUCOLOR II



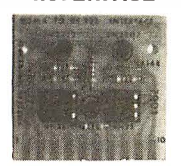
With reg. keyboard MOD3 BK $1449.95 MOD4 16 K $1495.95 MOD5 32K $1699.95 Without disk drive subtract $450.00. Add-on drives, $495.00. With 101 key option add $134.95. With 117 key option add $179.95.

44 BUS MOTHER BOARD



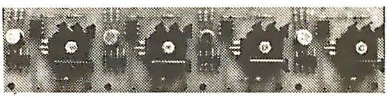
Has provisions for ten 44 pin (.156) connectors, spaced 3/4 of an inch apart. Pin 20 is connected to X, and 22 is connected to Z for power and ground. All the other pins are connected in parallel. This board also has provisions for bypass capacitors. Board cost $15.00 Part No. 102. Connectors $3.00 each Part No. 44WP.

RS-232/20mA INTERFACE



This board has two passive, opto-isolated circuits. One converts RS-232 to 20mA, the other converts 20mA to RS-232. All connections go to a 10 pin edge connector. Requires +12 and -12 volts. Board only $9.95, part no. 7901, with parts $14.95 Part No. 7901A.

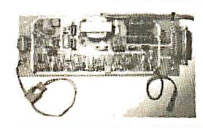
SOLID STATE SWITCH





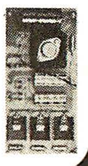
Your computer can control power (120VAC) to your printer, lights, and other 120VAC appliances up to 720 watts (6AMPS at 120VAC). Input 3 to 15 VDC, 2-13 MA TTL compatible, isolation 1500V. Part No. 79000K 1 Channel Kit $9.95 • Assm. $12.50 • Part No. 79004K 4 Channel Kit $34.95 • Assm. $44.95.

SUPER MODEM



Orignate, RS-232 and 20 mA compatable, Full duplex, and half duplex, direct connect or acoustic coupled, on board power supply, carrier detect light, DB25 plug, 300 BAUD, Type 103 compatable frequencies, Bare board Part No. 2000, $19,95, Kit Part No. 2000A, $99.95.

DC POWER SUPPLY



• Board supplies a regulated +5 volts at 3 amps., +12, -12, and -5 volts at 1 amp. • Power required is 8 volts AC at 3 amps., and 24 volts AC C.T. at 1.5 amps. • Board only $12.50 Part No. 6085, with parts excluding transformers $42.50 Part No. 6085A

Send for FREE Catalog...a big self addressed envelope with 80¢ postage gets it fastest!

To Order: Mention part no., description, and price. In USA shipping paid by us for orders accompanied by check or money order. We accept C.O.D. orders (U.S. only) or a VISA or Master Charge no., expiration date, signature and phone no., shipping charges will be added. CA residents add 6.5% for tax. Outside USA add 15% for air mail postage and handling. Payment must be in U.S. dollars. Dealer inquiries invited. Prices subject to change without notice.



Order Line: (408) 448-0800

ELECTRONIC SYSTEMS

Dept. B, P.O. Box 21638, San Jose, CA USA 95151

Circle 330 on inquiry card.

Circle 331 on inquiry card.

apple computer

$975 16K

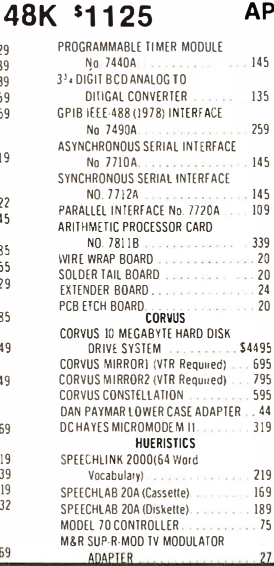
APPLE II OR APPLE II PLUS

32K $1050 48K $1125

The APPLE II is a completely assembled and tested computer system. The system includes a rugged molded case, typewriter-style keyboard with N-key rollover, high-efficiency switching power supply, two hand controllers, demonstration programs on tape cassettes, AC power cord, cassette cable, reference manuals.

APPLE II has ROM-resident Integer BASIC interpreter, monitor, mini-assembler and disassembler & BASIC Programming Manual.

APPLE II PLUS has ROM-resident Applesoft Extended BASIC interpreter, Auto-Start ROM, disassembler & Applesoft Tutorial Manual.



DISK II-DRIVE ONLY	$429
DISK II-DRIVE & CONTROLLER CARD	489
MODEM IIB W/INTERFACE	339
MODEM IIB ONLY (Novation Cat)	159
GRAPHICS TABLET	659
SILENTYPE PRINTER W/Apple Inteface	519
APPLE COMPUTER INTERFACE CARDS	
PROTOTYPING/HOBBY CARD	$22
PARALLEL PRINTER INTERFACE CARD	145
COMMUNICATION CARD & DB25 Connector Cable	185
HI-SPEED SERIAL INTERFACE CARD	155
LANGUAGE SYSTEM WITH PASCAL	429
CENTRONICS PRINTER INTERFACE CARD	185
APPLESOFT II FIRMWARE CARD W/Auto-Start ROM	149
INTEGER BASIC FIRMWARE CARD W/Mon. & Prog Aid ROMS	149
ADD-ONS	
16K MEMORY UPGRADE (TRS-80, Apple, Sorcerer)	$69
ABT NUMERIC INPUT KEYPAD (Old or New Kybrd)	119
ALF MUSIC SYNTHESIZER	239
ALF TIMING MODE INPUT BOARD	19
BRIGHTPEN LIGHTPEN from SOFTAPE	32
CALIFORNIA COMPUTER SYSTEMS	
12K ROM/PROM ASSEMBLED BOARD NO. 7114A	$69
PROGRAMMABLE TIMER MODULE No 7440A	145
3½ DIGIT BCD ANALOG TO DITIGAL CONVERTER	135
GPIB IEEE-488 (1978) INTERFACE No 7490A	259
ASYNCHRONOUS SERIAL INTERFACE No 7710A	145
SYNCHRONOUS SERIAL INTERFACE NO. 7712A	145
PARALLEL INTERFACE No. 7720A	109
ARITHMETIC PROCESSOR CARD NO. 7811B	339
WIRE WRAP BOARD	20
SOLDER TAIL BOARD	20
EXTENDER BOARD	24
PCB ETCH BOARD	20
CORVUS	
CORVUS 10 MEGABYTE HARD DISK DRIVE SYSTEM	$4495
CORVUS MIRROR1 (VTR Required)	695
CORVUS MIRROR2 (VTR Required)	795
CORVUS CONSTELLATION	595
DAN PAYMAR LOWER CASE ADAPTER	44
DC HAYES MICROMODEM II	319
HUERISTICS	
SPEECHLINK 2000(64 Word Vocabulary)	219
SPEECHLAB 20A (Cassette)	169
SPEECHLAB 20A (Diskette)	189
MODEL 70 CONTROLLER	75
M&R SUP-R-MOD TV MODULATOR ADAPTER	27
M&R SUP-R-TERMINAL 80 COLUMN BOARD	339
MICROSOFT Z-80 SOFTCARD SYSTEM W/CP/M	299
MICROWORKS DS-65 DIGISECTOR	339
MOUNTAIN HARDWARE	
APPLE CLOCK/CALENDER CARD	229
SUPERTALKER SPEECH SYNTHISIZER SYSTEM	249
ROMPLUS — w/KEYBOARD FILTER	169
ROMPLUS — wo/KEYBOARD FILTER	155
INTROL/X-10 REMOTE CONTROL SYSTEM	249
INTROL X-10 CONTROLLER ONLY	169
ROMWRITER SYSTEM	159
PROGRAMMA APPLE JOYSTICK	39
SEE-THRU CLEAR PLASTIC TOP FOR APPLE II	23
SSM A10 SERIAL/PARALLEL I/O CARD (KIT)	129
SSM A10 ASSEMBLED & TESTED	169
SYMTEC	
APPLE LIGHT PEN SYSTEM	219
SUPER SOUND GENERATOR (MONO)	139
SUPER SOUND GENERATOR (STEREO)	229
SVA 8 INCH DISK DRIVE CONTROLLER CARD	339
VERSAWRITER DIGITIZER DRAWING SYSTEM	219
VIDEX VIDEOTERM 80 COLUMN CARD	319
VIDEX VIDEOTERM W/GRAPHICS EPROM	339
APPLE II & APPLE II PLUS SOFTWARE	
PASCAL with LANGUAGE SYSTEM	$429
FORTRAN for use with LANGUAGE SYSTEM	169
CP/M for use with MICROSOFT Z-80 SOFTCARD	299
THE CONTROLLER General Business System	519
THE CASHIER Retail Management & Inventory	199
APPLEWRITER Word Processor	65
APPLEPOST Mailing List System	45
APPLEPOST Graph & Plot System	85
DOW JONES PORTFOLIO EVALUATOR	45
CONTRIBUTED VOLUMES I THRU 5 w/ MANUALS	35
VISI-CALC by PERSONAL SOFTWARE	125
DESKTOP/PLAN by DESKTOP COMPUTERS	85
CCA DATA MANAGEMENT By PERSONAL SOFTWARE	85
PIMS Personal Information Management System	23
ADVENTURE by MICROSOFT	27
SUB-LOGIC FS-1 Flight Simulator	23
SARGON II Chess by HAYDEN (Cass.)	27
SARGON II Chess on Diskette	32
Bill Budges TRILOGY of GAMES	27
Bill Budges SPACE GAME ALBUM	32
SPACE INVADER on cassette	18
SPACE INVADER on Diskette	23
SYBEX APPLE-80 8080 SIMULATOR	17
FORTH II by PROGRAMMA SOFTWARE	45
SINGLE DISK COPY ROUTINES	17
APPLEBUG ASSEMBLER/DISASSEMBLER	79
APPLEBUG DEBUGGER	27
APPLESOFT UTILITY PROGRAMS By HAYDEN	27
PRINTERS, TERMINALS & MONITORS	
ANADEX DP8000 or DP8000AP	$795
ANADEX DP9500 or DP9501	1395
BASE 2 w/TRACTOR & BUFFER	599
CENTRONICS 700-9	1099
CENTRONICS 737	849
MPI 88T	699
PAPER TIGER IDS 440	895
W/GRAPHICS OPTION	995
NEC SPINWRITER 5530 or 5510	2595
TRENDCOM 100	329
TRENDCOM 200	529
LEEDEX VIDEO 100	139
SANYO 9 INCH B&W MONITOR	159
SANYO 15 INCH MONITOR	249
TI 13 INCH COLOR MONITOR	429
SORDC IQ 120	729
SOROC IQ 140	1199
HAZELTINE 1500	979
HAZELTINE 1510	1079
HAZELTINE 1520	1379
HAZELTINE 1410	749
HAZELTINE 1420	829

master charge

ORDERING INFORMATION: Phone orders may be placed using Visa, Mastercard or bank wire transfer. Mail orders may send charge card number (include expiration date), cashiers check, money order or personal check (allow 2 weeks to clear). Please include telephone number with all orders. Foreign orders (excluding Military PO's) add 10% for shipping and funds must be in U.S. dollars. Shipping, handling and insurance in U.S. is 50¢ per lb. surface, $1.00 per lb. for air. No COD's or purchase orders. All prices subject to change and availability. Equipment is new and complete with manufacturer warranty.



"WE WILL NOT BE UNDER SOLD!"



6363 EL CAJON BLVD., SUITE 205, SAN DIEGO, CA. 92115 • (714) 579-0330

• SWEEPSTAKES • OVER $1700.00 IN PRIZES •

• GRAND PRIZE TRS-80™ • ENTER NOW! •

SUPERBRAIN™ BY INTER TEC — 64K $2995.00 • IN STOCK •

LETTER-QUALITY PRINTER BY CITOH — $2195.00

77 TRACK DISK DRIVES — $599.00

TRS-80™ 64K MODEL II — $3626.00

ORDER NOW TOLL FREE • 1 (800) 345-8102

PRINTERS

CENTRONICS
730 • $695 737 • $950 779 • $1175
NEC 5510, 5530 W TRACTORS $2950
PRINTER STANDS FROM $119

SOFTWARE

	OWNER'S MANUAL	MOD I	MOD II
MEDICAL/DENTAL PATIENT ACCOUNTING	$35		$1500
WORD PROCESSING (MAGIC WAND)	$50		$300
GENERAL LEDGER	$5	$149.95	$249
PAYROLL	$5	$99.95	$199
DATA BASE	$5	$149.95	$299

	TAPE	DISK
UPPER LOWER CASE MODIFICATION	$19.95	$24.95
COMPREHENSIVE DIAGNOSTICS	$34.95	$34.95
C/PM	$175	

DISK DRIVES $350.00 — MOD I TRS 80 COMPATIBLE

MODEL II DRIVES	
1 DRIVE SINGLE ENCLOSURE	$899
1 DRIVE MULTIPLE ENCLOSURE	$1069.50
ADDITIONAL DRIVES FOR MULT ENC	$540
HARD DISK DRIVE (10 MEG)	$5995
DISK HEAD CLEANING KIT	$14.95
4K L II TRS 80	$575.70
16K L II	$789.60
RS 232	$92.10
0 K EXPANSION INTERFACE	$278.10
16K EXPANSION INTERFACE	$376.10
32K EXPANSION INTERFACE	$474.10
TELEPHONE MODEM	$179.95
CRT EMULATOR BY INTERTEC	$895
CRT STANDS	FROM $139
ANTI STATIC MATS	$160

OTHER PRODUCTS AVAILABLE • CALL IF YOU DON'T SEE WHAT YOU NEED
DEALER INQUIRES INVITED • SERVICE CENTER OPEN NOW
ABOVE PRICES ARE CASH DISCOUNTED • CALL FOR OTHER TERMS

VR Data
777 HENDERSON BLVD.
FOLCROFT, PA 19032

ORDER TOLL-FREE
1-800-345-8102
LOCAL CALL
(215) 461-5300



V R DATA'S TRS-80™ SWEEPSTAKES

Celebrating V. R. DATA's 8th Anniversary

OVER $1700.00 in PRIZES
GRAND PRIZE - 16K LII TRS-80
TWO **SECOND PRIZES - DISK DRIVES**
FOUR **THIRD PRIZES - $50.00** Gift Certificates

SWEEPSTAKES RULES

1. ALL ENTRIES MUST BE SUBMITTED ON ORIGINAL ENTRY BLANK
2. ONE ENTRY PER PERSON
3. WINNERS SELECTED BY RANDOM DRAWING NOTIFIED BY MAIL
4. ENTRIES MUST BE RECEIVED BY 10 31 80
5. VOID WHERE PROHIBITED BY LAW NO PURCHASE NECESSARY

ENTER NOW! • EXPIRES 10-31-80

MAIL NOW TO ENTER V. R. DATA'S SWEEPSTAKES

NAME ______________________
ADDRESS ______________________
CITY ______________ STATE ______ ZIP ______
TELEPHONE ______________ OCCUPATION ______________
COMPUTER EQUIPMENT OWNED ______________________

INTENDED USE ______________________

B SEND FREE CATALOG ☐

Circle 332 on inquiry card.

WAMECO

THE COMPLETE PC BOARD HOUSE
EVERYTHING FOR THE S-100 BUSS

* **FPB-1** FRONT PANEL BOARD FOR 8080A AND Z80 SYSTEMS IMSAI COMPATIBLE.
  PCBD .... $56.95 KIT $175.00
* **MEM-2** 16K RAM 2114's. ADDRESSABLE IN 4K BOUNDARIES.
  PCBD .... $33.95 KIT (LESS RAMS) $80.95
* **EPM-2** 16/32K ROM USES 2716 OR 2708. ADDRESSABLE IN 4K BOUNDARIES.
  PCBD .... $33.95 KIT (LESS ROMS) $74.95
* **CPU-1** 8080A PROCESSOR BOARD WITH VECTOR INTERRUPT.
  PCBD .... $33.95 KIT $124.95
* **IOB-1** I/O BOARD. ONE SERIAL, TWO PARALLEL WITH CASSETTE. PCBD $33.95
* **FDC-1** FLOPPY DISC CONTROLLER BOARD USES 1771. PCBD $45.95
* **QMB-12** 13 SLOT MOTHER BOARD.
  PCBD .... $42.95 KIT $125.95
* **QMB-9** 9 SLOT MOTHER BOARD.
  PCBD .... $35.95 KIT $109.95
* **PTB-1** POWER SUPPLY AND TERMINATOR BOARD.
  PCBD .... $29.95 KIT $49.95
* **RTC-1** REAL TIME CLOCK BOARD WITH TWO INTERRUPTS.
  PCBD .... $29.95 KIT $79.95
* **MEM-1** 8K RAM, USES 2102's.
  PCBD .... $33.95 KIT (LESS RAM) $71.95
* **EPM-1** 4K 1702 BOARD.
  PCBD .... $29.95 KIT (LESS ROM) $59.95

FUTURE PRODUCTS: 80 CHARACTER VIDEO BOARD.
Z-80 CPU BOARD WITH ROM, 8 PARALLEL PORT I/O BOARD.

DEALER INQUIRIES INVITED, UNIVERSITY DISCOUNTS AVAILABLE AT YOUR LOCAL DEALER

MOST PRODUCTS FOR IMMEDIATE SHIPMENT. NO 4-8 WEEK DELAYS REQUIRED FOR OTHERS.



WAMECO, INC., P. O. BOX 877 • 455 PLAZA ALHAMBRA • EL GRANADA, CA 94018 • (415) 726-6378

Circle 334 on inquiry card.

Circle 335 on inquiry card.

CALIFORNIA COMPUTER SYSTEMS

16K RAM BOARD. Fully buffered addressable in 4K blocks. IEEE standard for bank addressing 2114's. PCBD .... $28.95 Kit 450 NSEC $249.95

PT-1 PROTO BOARD. Over 2,600 holes 4" regulators. All S-100 buss functions labeled, gold fingers. PCBD $28.95

PT-2 PROTO BOARD. Similar to PT-1 except set-up to handle solder tail sockets. PCBD .. $28.95

CCS MAIN FRAME. Kit (S-100) $339.95

APPLE EXTENDER. Kit $22.95

APPLE IEEE INSTRUMENTATION INTERFACE KIT 7490. Kit $275.00

ARITHMETIC PROCESSOR FOR APPLE 7811A. Kit $350.00

APPLE ASYNCHRONOUS SERIAL INTERFACE 7710A. Kit $89.95

APPLE SYNCHRONOUS SERIAL INTERFACE 7712A. Kit $89.95

ALL OTHER CCS PRODUCTS AVAILABLE

SSM

PB-1 2708 & 2716 Programming Board with provisions for 4K or 8K EPROM. No external supplies required. Textool sockets. Kit $149.95

CB-1A 8080 Processor Board. 2K of PROM 256 BYTE RAM power on/rest Vector Jump Parallel port with status. Kit .... $159.95 PCBD $34.95

VB-3 80x24 VIDEO BOARD. Graphics included. 4MHZ $379.95

IO-4 Two serial I/O ports with full handshaking 20/60 ma current loop: Two parallel I/O ports. Kit .... $174.95 PCBD $34.95

VB-IC 64 x 16 video board, upper lower case Greek composite and parallel video with software, S-100. Kit $145.95

CB-2 Z80 CPU BOARD. Kit $199.95

AIO APPLE SERIAL/PARALLEL $149.95

ALL OTHER SSM PRODUCTS AVAILABLE

WMC/inc. WAMECO INC.

FDC-1 FLOPPY CONTROLLER BOARD will drive shugart, pertek, remic 5" & 8" drives up to 8 drives, on board PROM with power boot up, will operate with CPM™ (not included). PCBD $43.95

FPB-1 Front Panel. IMSAI size, hex displays. Byte, or instruction single step. PCBD $48.50

MEM-1A 8K x 8 fully buffered, S-100, uses 2102 type rams. PCBD $28.95

QM-12 MOTHER BOARD, 13 slot, terminated, S-100 board only $39.95

CPU-1 8080A Processor board S-100 with 8 level vector interrupt. PCBD $28.95

RTC-1 Realtime clock board. Two independent interrupts. Software programmable. PCBD $25.95

EPM-1 1702A 4K Eprom card. PCBD $25.95

EPM-2 2708/2716 16K/32K EPROM CARD. PCBD $28.95

QM-9 MOTHER BOARD. Short Version of QM-12. 9 Slots. PCBD $33.95

MEM-2 16K x 8 Fully Buffered 2114 Board. PCBD $28.95

PTB-1 POWER SUPPLY AND TERMINATOR BOARD. PCBD $28.95

IOB-1 SERIAL AND PARALLEL INTERFACE. 2 parallel, one serial and cassette. PCBD $28.95

2708	$ 9.49	2114L 450 NSEC	$5.99
2716	$35.95	2114L 200 NSEC	$6.99

SEPT. SPECIAL SALE ON PREPAID ORDERS

(Charge cards not included on this offer)

MIKOS PARTS WITH WAMECO PCBDS.
10% OFF OF NORMAL PRICE.

MIKOS PARTS ASSORTMENT WITH WAMECO AND CYBERCOM PCBDS

MEM-2 with MIKOS #7 16K ram with L2114 450 NSEC $249.95

MEM-2 with MIKOS #13 16K ram with L2114 250 NSEC $279.95

CPU-1 with MIKOS #2 8080A CPU $99.95

QM-12 with MIKOS #4 13 slot mother board $110.95

RTC-1 with MIKOS #5 real time clock $65.95

EMP-1 with MIKOS #10 4K 1702 less EPROMS .... $ 49.95

EPM-2 with MIKOS #11 16-32K EPROMS less EPROMS $65.95

QM-9 with MIKOS #12 9 slot mother board $99.95

FPB-1 with MIKOS #14 all parts for front panel $144.95

MIKOS PARTS ASSORTMENTS ARE ALL FACTORY MARKED PARTS. KITS INCLUDE ALL PARTS LISTED AS REQUIRED FOR THE COMPLETE KIT LESS PARTS LISTED. ALL SOCKETS INCLUDED.

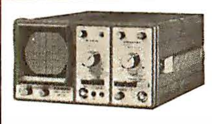
LARGE SELECTION OF LS TTL AVAILABLE

MIKOS

(415) 726-7593
P. O. Box 955 • El Granada, CA 94018
Please send for IC, Xistor and Computer parts list

VISA or MASTERCHARGE. Send account number, interbank number, expiration date and sign your order. Approx. postage will be added. Check or money order will be sent post paid in U.S. If you are not a regular customer, please use charge, cashier's check or postal money order. Otherwise there will be a two-week delay for checks to clear. Calif. residents add 6% tax. Money back 30-day guarantee. We cannot accept returned IC's that have been soldered to. Prices subject to change without notice. **$10 minimum order. $1.50 service charge on orders less than $10.00.**

NEW PRODUCTS — HAMEG OSCILLOSCOPES



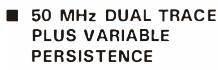
10 Megahertz
HM307
SINGLE TRACE OSCILLOSCOPE

- IDEAL SERVICE INSTRUMENT
- TIMEBASE 0.2 μs-0.2 s/cm
- LPS-TRIGGER ■ COMPACT
- BUILT-IN COMPONENT TESTER $404.25

20 Megahertz
HM312
DUAL TRACE OSCILLOSCOPE

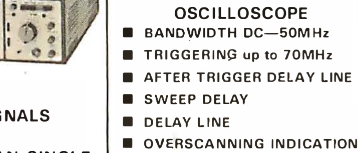
- 10 X 8 cm DISPLAY
- LPS-TRIGGERING
- BANDWIDTH DC—20MHz
- TRIGGERING up to 30MHz
- FULL X—Y OPERATION $609.00

50 Megahertz
HM812
DUAL TRACE STORAGE OSCILLOSCOPE



- 50 MHz DUAL TRACE PLUS VARIABLE PERSISTENCE
- DELAYED SWEEP WITH AFTER DELAY TRIGGERING
- STORAGE OF SINGLE-SHOT- SIGNALS "AUTOMATIC STORE"
- LED INDICATION FOR OVERSCAN, SINGLE SHOT, TRIGGER ACTION DELAY MODE, AUTOMATIC STORE $4032.00

50 Megahertz
HM512
DUAL TRACE OSCILLOSCOPE



- BANDWIDTH DC—50MHz
- TRIGGERING up to 70MHz
- AFTER TRIGGER DELAY LINE
- SWEEP DELAY
- DELAY LINE
- OVERSCANNING INDICATION
- BRIGHT DISPLAY
- IDEAL FOR COMMUNICATIONS AND DATA PROCESSING $1485.75

Capacitance Meter

- Easy to use - plug in capacitor, push range button and read the value to 0.1%
- 0.5 in. liquid crystal display
- Exclusive "Δcharge/Δvolt" measurement circuit (potent pending) holds ±0.1% basic accuracy for a full year.
- Up to 200 hrs operation on standard 9V Batt.
- 8 easy pushbutton ranges cover 0.1pf to 1999 microferads.
- Best of all it's easy on the budget - only

MODEL 938 $179

2716 EPROM
5 volt 16K **$18.80**
Order 2pcs and Get 5% Discount — Order 5pcs and Get 10% Discount

LIQUID CRYSTAL DISPLAY
- High Contrast Ratio
- Wide Viewing Angle
- 0.5 in. Digit Height
- ULTRA Low Power Consumption

LCD106 .... $13.50

30 MHz HITACHI Dual Trace Oscilloscope



- TV sync-separater circuit
- High-sensitivity 1mV/div (5MHz)
- Sweep-time magnifier (10 times)
- Z-axis input (Intensity modulation)
- Signal delay line
- X-Y operation
- Trace Rotation

$945.00

More sensitive to your input

Sanken HYBRID AUDIO POWER AMPLIFIERS

P/N		* Matching Transformer	
SI-1010G(10W)	$ 6.95	TR10	$ 7.90
SI-1020G(20W)	$13.95	TR20	$10.90
A-SI-8(Socket for above)			.95
SI-1030G(30W)	$19.00	TR30	$12.90
SI-1050G(50W)	$27.80	TR50	$17.90
A-SI-10(Socket for above)			.95

* Note: One Transformer can power two audio amplifiers.

Power Supplies from ADTECH POWER

Model	Vdc	Amps	Model	Vdc	Amps
APS 5-3	5	3.0	APS 5-6	5	6.0
APS 12-1.6	12	1.6	APS 12-4	12	5.0
APS 15-1.5	15	1.5	APS 15-3	15	3.0
APS 24-1	24	1.0	APS 24-2.2	24	2.2

1-9	10 up	25 up	1-9	10 up	25 up
$42.50	$40.65	$38.85	$66.90	$64.00	$61.10

Intersil LED or LCD 3½ DIGIT PANEL METER KITS

BUILD A WORKING DPM IN ½ HOUR WITH THESE COMPLETE EVALUATION KITS

Test these new parts for yourself with Intersil's low cost prototyping kits, complete with A/D converter and LCD display (7106) or LED display (7107). Kits provide all materials, incl PC board, for a functioning panel meter.

ICL7106EV (LCD) .... $29.95 ICL7107EV (LED) $24.95

SYM-1 NEW LOW PRICE



$239.00
KTM-2 CRT/TV Kybd Term $349

FLUKE
8022A $139
8020A $179
8024A $219

8 Digit - 10 MHz Universal Counter Kit

Kit Includes:
- ICM7226AIDC IC
- 10 MHz Quartz Crystal
- (8) 7 Segment .3" LED Displays
- PC Board
- Resistors
- Capacitors
- Diodes
- Switches
- IC Socket

Order Part Number ICM7226AEV $74.95

ANCRONA

Send check or Money Order to: **P.O. Box 2208Y, Culver City CA 90230.** California residents add 6% sales tax. Minimum Order: $10.00. Add $1.00 to cover postage and handling. Master Charge and Visa welcomed. Please include your charge card number. Interbank number and expiration date. **PHONE ORDERS: (213) 641-4064**

TUCSON	CULVER CITY	SANTA ANA	PORTLAND
4518 E. Broadway Tucson, AZ 85711 (602) 881-2348	11080 Jefferson Blvd Culver City, CA 90230 (213) 390-3595	1300 E. Edinger Ave Santa Ana, CA 92705 (714) 547-8424	1125 N.E. 82nd Ave. Portland, OR 97220 (503) 254-5541
CANADA, B.C. ANCRONA 5656 Fraser St. Vancouver, B.C. V5W2V4 (604) 324-0707	**SUNNYVALE** 1054 E. El Camino Real Sunnyvale, CA 94087 (408) 243-4121	**ATLANTA** 3330 Piedmont Rd. N.E. Atlanta, GA 30305 (404) 261-7100	**HOUSTON** 2649 Richmond Houston, TX 77098 (713) 529-3489

Circle 336 on inquiry card.

BECKIAN ENTERPRISES

ALL PRIME QUALITY — NEW PARTS ONLY
SATISFACTION GUARANTEED.

EDGE CARD CONNECTORS: GOLD PLATED:

Abbreviations: S/E Solder Eye . S/T Sold Tail: W/W Wire Wrap.

PART #	DESCRIPTION.	Row Sp.	1-9pc.	10-24pcs.	25pcs. Up.
BRAND: TEXAS INST.					
4070	50/100 Imsai/Crom.	.250	$3.95ea.	$3.55ea.	$3.15ea.
4090	50/100 Imsai W/W	.250	4.30ea.	3.65ea.	3.45ea.
BRAND: SULLINS: U.L Reg.					
129665	50/100 Solder Eye	.140	6.60ea.	6.10ea.	5.45ea.
129670	50/100 S/T Imsai	.250	4.50ea.	4.10ea.	3.70
129875	50/100 W/W Imsai	.250	5.25	4.75	4.20
129685	50/100 S/T Altair	.140	4.95	4.45	3.95
129990	50/100 S/T Cromem.	.250	4.75	4.25	3.80
OTHER .125" CONTACT CTR CONNECTORS:					
12305	22/44 S/E No Ears	.140	4.15	3.75	3.35
12759	36/72 S/T	.140	5.40	4.85	4.35
12790	40/80 W/W	.250	6.30	5.65	5.00
.100" CONTACT CTR CONNECTORS:					
10046	13/26 S/E No Ears	.140	3.40	3.05	2.15
10280	25/50 S/E TRS 80	.140	4.50	4.05	3.60
10175	20/40 S/E TRS 80	.140	5.85	5.35	4.75
10180	20/40 W/W TRS 80	.200	3.30	3.00	2.15
10190	20/40 S/T TRS 80	.140	3.20	2.90	2.55
10485	36/72 S/E Vector	.140	5.50	4.90	4.40
10490	36/72 W/E Vector	.200	5.80	5.25	4.65
10500	36/72 S/T Vector	.140	5.70	4.20	4.60
10535	40/80 S/E PET	.140	5.85	5.35	4.75
10540	40/80 W/W PET	.200	6.00	5.40	4.80
10550	40/80 S/T PET	.140	5.80	5.25	4.65
10585	43/86 S/E COS/ELF	.140	6.95	6.25	5.55
10605	43/86 S/T COS/ELF	.140	6.60	5.95	5.30
10595	43/86 W/W COS/ELF	.200	6.90	6.20	5.95
10615	43/86 S/T COS/ELF	.200	6.80	8.10	5.40

.156" CONTACT CENTER CONNECTORS.

PART #	DESCRIPTION.	Row Sp.	1-9pc.	10-24pcs.	25pcs. Up.
15105	6/12 S/E PET/NSC	.140	$1.80	$1.65	$1.45
15110	6/12 S/T PET/NSC	.140	1.65	1.65	1.50
15137	6/12 S/T PET/NSC	.200	1.60	1.54	1.45
15175	6/- S/E Sgle Row	- -	1.70	1.50	1.30
15270	10/20 S/E	.140	2.15	1.95	1.70
15275	10/20 S/T	.140	2.00	1.85	1.60
15435	12/24 S/E PET	.140	2.60	2.35	2.10
15440	12/24 S/T PET	.140	2.65	2.40	2.15
15445	12/24 S/T PET	.200	2.75	2.50	2.20
15505	15/30 S/E GRI Key	.140	2.50	2.25	2.00
15510	15/30 S/T GRI Key	.140	2.40	2.15	2.95
15515	15/30 W/W GRI Key	.200	2.60	2.35	2.10
15600	18/36 S/E	.140	3.35	3.05	2.70
15610	18/36 S/T	.140	3.00	2.70	2.40
15615	18/36 W/W	.200	3.60	3.20	2.90
15700	22/44 S/E KIM/VEC	.140	2.98	2.90	2.75
15705	22/44 S/T KIM/VEC	.140	3.98	3.30	3.00
15710	22/44 W/W KIM/VEC	.200	3.49	3.20	2.85
15875	25/50 S/E	.140	4.65	4.20	3.75
15880	25/50 S/T	.140	4.55	4.10	3.65
15885	25/50 W/W	.200	4.85	4.35	3.90
16115	36/72 S/E	.140	6.50	5.85	5.20
16120	36/72 S/T	.140	8.55	5.90	5.25
16125	36/72 W/W	.200	6.75	6.10	5.40
16145	36/72 S/T	.200	6.50	5.85	5.20
16235	43/86 S/T Mot 6800	.140	6.60	5.95	5.30
16240	43/86 W/W Mot 6800	.200	7.80	7.05	6.25
16260	43/86 S/T Mot 6800	.200	6.50	5.85	5.20
16725	43/86 S/E Mot 6800	.140	7.20	6.50	5.75
K-1	Pol-Keys		.15	.12	.10

'D' TYPE SUBMINIATURE CONNECTORS.

PART NUMBER		DESCRIPTION.	QUANTITY 1-9pcs.	10-24pcs.	25-99pcs.
DE	9P	Male	$1.60ea.	$1.40ea.	$1.30ea.
DE	9S	Female	2.25ea.	2.00ea.	1.90ea.
DE	110963-1	2 pc. Grey Hood.	1.50ea.	1.35ea.	1.20ea.
DA	15P	Male	2.35ea.	2.15ea.	2.00ea.
DA	15S	Female	3.25ea.	3.10ea.	2.90ea.
DA	51211-1	1. pc. Grey Hood	1.40ea.	1.20ea.	1.15ea.
DA	51226-1	2 pc. Black Hood	2.50ea.	2.25ea.	2.00ea.
DA	110963-2	2 pc. Gray Hood	1.60ea.	1.35ea.	1.30ea.
DB	25P	Male	2.60ea.	2.60ea.	2.40ea.
DB	25S	Female	3.60ea.	3.40ea.	3.20ea.
DB	51212-1	1 pc. Grey Hood	1.50ea.	1.30ea.	1.10ea.
DB	51226-1	2 pc. Black Hood	1.90ea.	1.65ea.	1.45ea.
DB	110963-3	2 pc. Gray Hood	1.75ea.	1.50ea.	1.35ea.
DC	37P	Male	4.20ea.	4.00ea.	3.70ea.
DC	37S	Female	6.00ea.	5.75ea.	5.50ea.
DC	110963-4	2 pc. Gray Hood	2.25ea.	2.00ea.	1.75ea.
DD	50P	Male	5.50ea.	5.10ea.	4.75ea.
DD	50S	Female	9.40ea.	8.60ea.	8.00ea.
DD	51216-1	1 pc. Gray Hood	2.40ea.	2.20ea.	2. 00ea.
DD	110963-5	2 pc. Grey Hood	2.60ea.	2.40ea.	2.10ea.
D	20418-2	Hardware Set (1 Hood Set)	.90ea.	.80ea.	.70ea.

I.C. SOCKETS GOLD. W/WRAP 3 TURN

14 pin	$0.40 ea.
16 pin	0.44 ea.

8080A PRIME. $5.00 ea.

EIA 8 CONDUCTOR CABLES 8ft. Long. CLASS #1 Type Cables.

1. to 4 pcs.	$22.00
5 to 9 pcs.	19.00

I.C. SOCKETS TIN.

14 pin	$0.15 ea.
16 pin	0.17 ea.

CONNECTORS FOR CENTRONICS 700 SERIES. Amphenol 57-30360

1 to 4 pcs.	$8.00 ea.
5 to 9 pcs.	6.00 ea.

COOLING FANS. Extra Quiet.

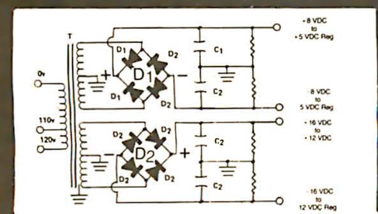
1 to 4	$18.00 ea.
5 to 9	17.00 ea.

TERMS: MINIMUM ORDER: $15.00 ADD $1.35 For Handling & Shipping. Orders over $30.00 in the U.S.A. We Pay the Shipping. CALIF. RESIDENTS: Please Add 6% Sales Tax.

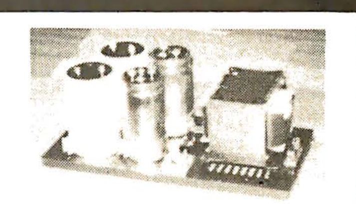
NOTE: NO C.O.D. OR CREDIT CARD ORDERS WILL BE ACCEPTED.

PHONE: 213-988-6196

MAIL ORDERS TO: **BECKIAN ENTERPRISES**
P.O. BOX #3089
SIMI VALLEY, CA 93063



BUILD YOUR OWN LOW COST MICRO-COMPUTER POWER SUPPLIES FOR S-100 BUS, FLOPPY DISCS, ETC.



POWER TRANSFORMERS (WITH MOUNTING BRACKETS)

ITEM NO.	USED IN KIT NO.	PRI. WINDING TAPS	SECONDARY WINDING OUTPUTS 2×8 Vac	2×14 Vac	2×24 Vac	SIZE W × D × H	UNIT PRICE
T_1	1	0V, 110V, 120V	2×7.5A	2×2.5A	———	3¾"×3⅝"×3⅛"	21.95
T_2	2	0V, 110V, 120V	2×12.5A	2×3.5A	———	3¾"×4⅜"×3⅛"	27.95
T_3	3	0V, 110V, 120V	2×9A	2×2.5A	2×2.5A	3¾"×4⅜"×3⅛"	29.95
T_4	4	0V, 110V, 120V	2×4A	(28V, CT)	48V, CT, @3A	3¾"×3⅝"×3⅛"	22.95

POWER SUPPLY KITS (OPEN FRAME WITH BASE PLATE, 3 HRS. ASSY. TIME)

ITEM	USED FOR	@+8 Vdc	@−8 Vdc	@+16 Vdc	@−16 Vdc	@+28 Vdc	SIZE W×D×H	UNIT PRICE
KIT 1	15 CARDS SOURCE	15A	———	2.5A	2.5A	———	12"×6"×4⅞"	51.95
KIT 2	SYSTEM SOURCE	25A	———	3A	3A	———	12"×6"×4⅞"	58.95
KIT 3	DISC SYSTEM	15A	1A	2A	2A	4A	14"×6"×4⅞"	66.95
KIT 4	DISC SOURCE	8A	1A	*(SEE OPTION BELOW)		5A	10"×6"×4⅞"	49.95

EACH KIT INCLUDES: TRANSFORMER, CAPACITORS, RESIS., BRIDGE RECTIFIERS, FUSE & HOLDER, TERMINAL BLOCK, BASE PLATE, MOUNTING PARTS AND INSTRUCTIONS. *OPTION OF KIT 4: REPLACE +28V @ 5A BY +16 @ 6A.

DISC DRIVE POWER SUPPLY "R3"

ASSY. & TESTED, OPEN FRAME, SIZE: 9" (W) × 5" (D) × 5" (H) 66.95

SPECS: +5V @ 5A REGUL, OVP, −5V @ 1A REG., +24 @ 5A REG., SHORTS PROTECT. OPTIONS: REPLACE −5V & +24V BY EITHER −5V @ 1A & +12V @ 6A OR −12V @ 1A & +12 V @ 6A

IDEAL FOR 2 SHUGART 801/851 OR SIEMANS FDD 100-8/200-8 DISK DRIVES & ROCKWELL AIM-65.

SHIPPING FOR EACH TRANSFORMER: $4.75. FOR EACH POWER SUPPLY: $5.00 IN CALIF. $7.00 IN OTHER STATES. CALIF. RESIDENTS ADD 6% SALES TAX. OEM WELCOME.



MAIL ORDER:
P.O. BOX 4296
TORRANCE, CA 90510

SUNNY INTERNATIONAL
(TRANSFORMERS MANUFACTURER)
Telephone: (213) 633-8327

STORE:
7245 E. ALONDRA BLVD.
PARAMOUNT, CA 90723
STORE HOURS: 9 AM–6 PM



HOBBYWORLD®

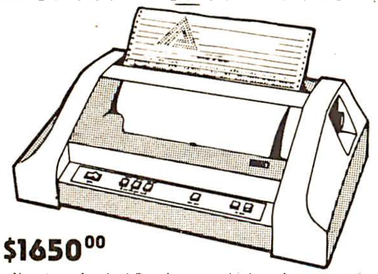
ELECTRONICS, INC.

19511 BUSINESS CTR. DR. DEPT B9
NORTHRIDGE, CALIFORNIA 91324

Send For Your Free Flyer Today!

ANADEX

DP9500/DP9501 PRINTERS



$1650[00]

New from Anadex! Two low cost, high performance printers designed for all applications, including standard high-density graphics capability. Both models feature a 9 wire print head with an incredible life expectancy of 650 million printed characters! Full 96 character ASCII set with lower case descenders, double width printing, bi-directional with shortest distance sensing logic. Adjustable-width tractor feed, forms control, horizontal and vertical tabbing, and print up to five copies. Easy interfacing with parallel, RS-232 serial or current loop choices.

The DP9500 is the choice when you require mostly printing and occasional graphics. Select between a 9 x 9 character font and 132 columns, or a 7 x 9 font for 175 columns. Printer speed: 150/200 CPS. Wt. 35 lbs.

The DP9501 is mainly for graphics applications. The 11 x 9 character font produces superb graphics reproduction in 132 columns, and the 7 x 9 character font in 220 columns provides maximum graphics potential. Both models operate at 110VAC, and 220 VAC for European use. Wt 35 lbs.

Cat No. 2551 DP9500 printer
Cat No. 2552 DP9501 printer

74L$ Order by Cat No. 999 and Type

74LS00	$ .33	74LS74	$ .99	74LS161	$3.75	74LS257	$ .99
74LS01	$ .29	74LS75	$ .59	74LS162	$1.19	74LS258	$ .66
74LS02	$ .49	74LS76	$ .44	74LS163	$1.15	74LS259	$1.99
74LS03	$ .29	74LS83	$ .88	74LS164	$1.15	74LS260	$ .66
74LS04	$ .49	74LS85	$1.15	74LS165	$1.69	74LS261	$2.50
74LS05	$ .35	74LS86	$ .99	74LS166	$3.95	74LS266	$ .66
74LS08	$ .44	74LS90	$ .59	74LS168	$1.29	74LS273	$3.25
74LS09	$ .29	74LS92	$ .75	74LS169	$3.33	74LS275	$4.95
74LS10	$ .44	74LS93	$ .75	74LS170	$2.25	74LS279	$ .49
74LS11	$ .29	74LS95	$ .88	74LS173	$1.25	74LS283	$1.75
74LS12	$ .29	74LS107	$ .55	74LS174	$1.10	74LS293	$1.99
74LS13	$ .55	74LS109	$ .55	74LS175	$ .99	74LS295	$1.99
74LS14	$1.10	74LS112	$ .55	74LS181	$2.50	74LS298	$1.10
74LS15	$ .35	74LS113	$ .55	74LS190	$ .69	74LS324	$1.75
74LS20	$ .29	74LS114	$ .55	74LS191	$1.15	74LS365	$ .99
74LS21	$ .39	74LS122	$ .55	74LS192	$ .99	74LS366	$ .89
74LS22	$ .29	74LS123	$1.15	74LS193	$1.15	74LS367	$ .99
74LS26	$ .77	74LS124	$1.55	74LS194	$1.15	74LS368	$ .99
74LS27	$ .55	74LS125	$ .88	74LS195	$1.15	74LS373	$3.25
74LS28	$ .44	74LS126	$ .88	74LS196	$ .99	74LS374	$4.50
74LS30	$ .39	74LS132	$ .88	74LS197	$1.99	74LS377	$3.25
74LS32	$ .66	74LS138	$1.25	74LS221	$1.99	74LS378	$1.69
74LS33	$ .69	74LS139	$ .99	74LS240	$3.95	74LS386	$ .77
74LS37	$ .39	74LS145	$1.99	74LS241	$2.95	74LS393	$2.25
74LS38	$ .59	74LS147	$2.95	74LS242	$1.95	74LS395	$1.99
74LS40	$ .33	74LS151	$ .88	74LS243	$2.95	74LS399	$2.95
74LS42	$ .88	74LS153	$ .88	74LS244	$3.25	74LS424	$3.25
74LS47	$ .88	74LS154	$3.50	74LS245	$5.00	74LS670	$2.25
74LS48	$ .88	74LS155	$ .99	74LS247	$ .88	81LS95	$1.95
74LS51	$ .39	74LS156	$1.25	74LS248	$ .99	81LS96	$1.95
74LS54	$ .29	74LS157	$1.25	74LS251	$1.99	81LS97	$1.95
74LS55	$ .55	74LS158	$1.49	74LS253	$ .99	81LS98	$1.95
74LS73	$ .44	74LS160	$ .99	74LS256	$2.25		

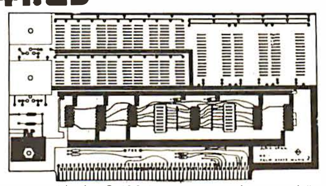
TTL's Order by Cat No. 999 and Type

7400	$.35	7445	$ .77	74109	$ .55	74176	$ .79
7401	$.35	7446	$ .69	74116	$1.89	74177	$ .77
7402	$.35	7447	$ .66	74120	$ .99	74179	$1.88
7404	$.44	7448	$ .77	74121	$ .44	74180	$ .77
7405	$.44	7450	$ .20	74122	$ .50	74181	$1.88
7406	$.39	7451	$ .50	74123	$ .52	74182	$1.99
7407	$.39	7453	$ .50	74125	$ .52	74184	$1.99
7408	$.35	7454	$ .20	74126	$ .49	74185	$1.99
7409	$.35	7460	$ .29	74132	$ .69	74190	$1.19
7410	$.35	7470	$ .29	74141	$ .77	74191	$1.19
7411	$.39	7472	$ .29	74143	$3.33	74192	$ .77
7412	$.49	7473	$ .36	74145	$7.77	74193	$ .89
7413	$.44	7474	$ .49	74148	$1.29	74195	$ .69
7414	$.66	7475	$ .49	74150	$ .88	74196	$ .88
7416	$.45	7476	$ .38	74151	$ .59	74197	$ .88
7417	$.29	7479	$3.99	74153	$ .69	74198	$1.49
7420	$.35	7480	$ .50	74155	$ .49	74199	$1.49
7422	$.44	7481	$ .99	74156	$ .99	74221	$1.99
7423	$.44	7483	$ .59	74157	$ .63	74251	$ .77
7425	$.38	7485	$ .85	74160	$ .77	74273	$1.10
7426	$.39	7486	$ .35	74161	$ .79	74278	$2.95
7427	$.35	7489	$1.66	74162	$ .79	74279	$ .82
7430	$.35	7490	$ .44	74163	$ .88	74365	$ .69
7432	$.39	7491	$ .59	74164	$ .88	74366	$ .69
7437	$.39	7492	$ .45	74165	$ .88	74367	$ .69
8438	$.39	7493	$ .45	74166	$1.29	74368	$ .69
7440	$.20	7495	$ .65	74170	$1.59	74393	$2.50
7441	$.77	7496	$ .65	74173	$1.09	8T26	$2.50
7442	$.49	74100	$1.69	74174	$ .79	8T97	$2.25
7433	$.69	74107	$ .44	74175	$ .79		

SSM OB1

VECTOR JUMP & PROTOTYPING CARD

$41.25*

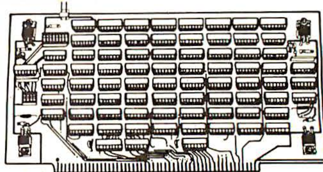


Plug compatible for S-100 bus systems, features full 16 bit vector jump address with dip selection of 8080 or Z80. Can be set to jump on power-on-clear, reset, or both. Prototyping areas on the card for ten 16-pin IC's three 24-28 pin IC's and two spare regulator patterns.

*Cat No. 1429 OB1 kit	$41.25
Cat No. 1430 OB1 a & t	$85.00
Cat No. 1431 OB1 bareboard	$32.00

SSM MB6B

8K STATIC RAM BOARD



8K bytes by 8 bits, fully buffered, compatible with 8080, 8085, and Z80. Dip switch addressing of independant 4K halves lets the MB6B think like two 4K boards, or one 8K board. Independent 4K addressing allows the flexibility to meet varying software memory needs. Uses low power 21L02 RAM's, operates at 2 or 4MHZ, and is compatible with direct memory access controllers.

Cat No.	Description	Price
*1400-A	450ns kit	$135.00
*1400-B	250ns kit	$147.50
1401-A	450ns a & t	$209.00
1401-B	250ns a & t	$225.00
*1402	Bareboard	$ 23.75

GALACTIC TRILOGY
by BRODERBUND

GALACTIC EMPIRE

Your superior ability in planning, logistics and tactical maneuvering, along with building the manufacturing and military capabilities of the planets that you control, can bring the central galactic empire under one flag. A special "save" routine gives you the option storing a game in progress. Fun and educational!
Cat No. 2584 TRS-80 L2, 16K, cassette

GALACTIC TRADER

Gives you the opportunity to be a big time wheeler dealer. You will seek out the origins of various commodities, and buy cheap. You may then sell them at exhorbitant rates or barter for local goods. Your good business sense and level head allow you to out-think the sharpest business creatures in the galaxy! Ten levels of difficulty allow you to increase your skill without out growing the game.
Cat No. 2585 TRS-80 L2, 16K, cassette

GALACTIC REVOLUTION

In the final game of this galactic trilogy, you will be a diplomat and administrator of unequalled accomplishments. Your prowess at manipulation will decide if various power groups will be swayed to your side, and your military leadership will put the finishing touches on a successful revolution.
Cat No. 2586 TRS-80 L2, 16K, cassette

$11[95] each
All 3 for $29[95]

"PIRATES COVE" ADVENTURE

In addition to being a challenging and innovative game, Pirates Cove is designed so that different adventures can be created by changing the data base. While playing the game you wander thru various rooms and, by manipulating the objects, you try to find the hidden "treasures". You may have to defeat a wild animal to get to the treasure, or figure out how to get it out of the bog. A game in progress may be saved on tape and used later.
Cat No. 2505 TRS-80 L2, 16K cassette $24[95]

SOUNDING BOARD
for Apple II

Enter the world of microcomputer music and sounds! One board will turn your apple into a fine musical instrument and, in addition, produce sound effects which will spice up any program. Each board has three programmable voices, and on-board generator and built-in amplifier which can drive an 8 ohm speaker. The Sounding Board has a five octave range starting at 55hz which is (a) below the bass clef, to 1760hz which is 2 octaves above the treble clef. The apple will hold 6 boards which would give you the capacity to create 18 simultaneously programmable voices. Music can be composed, edited, played and then stored. Musical notes can be entered directly from the keyboard, included with your board is an interactive music editor, sample music, and a demonstration program which plays continuous music. Wt 3 oz.
Cat No. 2561 $129[95]

NEWDOS + TRS-80 DOS

Contains the following: NEWDOS provides fixes for many of TRSDOS 2.1's problems. Enhancements to BASIC include built-in renumbering, some abbreviated commands, scrolling of listings up or down, screen printing, clears up keyboard bounce, append now works, direct call to DOS without leaving BASIC, and display of all variables used; DIRCHECK tests and lists disk directories; DISASSEM, which is a disassembler; EDTASM allows the use of the Radio Shack Editor-Assembler on disk with disk I/O Level 1 in Level 2. This allows you to use or create Level 1 programs and also save or retrieve them from disk using LVIDSKSL; LMOFFSET helps save and load machine language tapes from disk, even if in the same memory as DOS; SUPERZAP allows you to display, print, and modify disks or memory. Complete with extensive documentation, requires TRSDOS and the Radio Shack Editor-Assembler.
Cat No. 1549 TRS-80 L2, 16K w/disk $99[00]

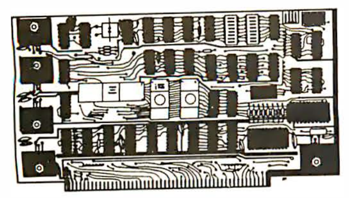
APPLE INVADERS

You have mobile bases, the invaders have missiles. As the game progresses the invaders get closer with every pass across the screen . . . the more you destroy, the faster those remaining will attack! This game can continue for quite some time, as there is a never ending supply of invaders.

Cat No.	2420	24K Apple Disk Version	6 oz.	$19.95
Cat No.	2421	24K Apple Cassette	6 oz.	$13.95

Call Toll-Free: USA (800) 423-5387
In California: (800) 382-3651
Local & Outside USA: (213) 886-9200

Circle 339 on inquiry card



SSM CB1-A
8080 CPU BOARD

$159 kit

Just add an I/O board and it's a computer! 256 bytes of on board RAM, with option for 2K of on board PROM. Includes a power-on, preset jump circuit, and MWRITE is available, allowing use without a front panel. There's a parallel input port with status, and AIP controlled addressing: or PROM in 2K blocks; vector jump in 2K increments; RAM in 256 byte increments; RAM in 256 byte increments; input port for addresses 0=31 in decimal.

*Cat No. 1403	CB1-A kit	$159.00
*Cat No. 1441	CB1-A bareboard	$28.75

* Denotes excess inventory sale. No further discounts shall apply

TEAC FD-50A MINI DISK DRIVE
$295

The engineering expertise of TEAC has been incorporated into a new mini-disk drive for personal computer owners who demand the best from their investment.

The FD-50A has a unique "brushless" DC motor that is designed to run continuously and noise-lessly to provide faster track-to-track access time. (Less than 25ms access time!) The FD-50A will access 35 or 40 tracks providing 110/125k bytes storage capacity and may be ordered pin to pin compatible with either the Shugart SA-400 or the MPI-51 disk drives.

With its ONE FULL YEAR warranty, the FD-50A is certainly a sensible alternative. Compare the new TEAC FD-50A before you purchase your next mini-disk drive. Wt. 5 lbs.

Cat No. 2680 FD-50A Compatible w/SA-400 Format
Cat No. 2681 FD-50A Compatible w/MPI-51 Format

ATARI HOME VIDEO SYSTEM



$183.00

The nation's best selling home video entertainment center is here! Currently supports a library of 32 game cartridges with over 1500 game variations and options. Now you can enjoy all the fun and excitement of an arcade in your own home whenever you wish. Terrific for party entertainment, developing coordination and dexterity, education, or just plain family fun. Comes with interchangeable joystick and paddle controllers, special circuits to protect home T.V., and ATARI'S realistic "combat" game with 108 variations and options. ATARI'S realistic sound effects and crisp, bright colors make the home video center your number one entertainment choice.

Note: Not for use with ATARI Programmable Computers

CAT NO.	DESCRIPTION	WT	PRICE
2375	ATARI Home Video System	8 lb.	183.00
2206	Driving Controller-Pair	2 lb.	19.95
2207	Paddle Controller-Pair	2 lb.	19.95
2208	Joystick Controller-Pair	2 lb.	19.95

ATARI GAME CARTRIDGES

2376	Starship	6 oz.	19.50
2377	Black Jack	6 oz.	18.75
2378	Space War	6 oz.	12.95
2379	Surround	6 oz.	12.95
2380	Slot Machine	6 oz.	18.75
2381	Outlaw	6 oz.	19.50
2382	Slot Racer	6 oz.	19.50
2383	Video Olympics	6 oz.	19.50
2384	Breakout	6 oz.	19.50
2385	Canyon Bomber	6 oz.	19.50
2386	Street Racer	6 oz.	19.50
2387	Homerun	6 oz.	19.50
2388	Basketball	6 oz.	19.50
2389	Football	6 oz.	19.50
2390	Bowling	6 oz.	19.50
2391	Skydiver	6 oz.	19.50
2392	Fun with Numbers	6 oz.	18.75
2393	Brain Game	6 oz.	19.50
2394	Superman	6 oz.	25.00
2395	Casino	6 oz.	25.00
2396	Backgammon	6 oz.	37.95
2397	Video Chess	6 oz.	37.95
2500	Space Invaders	6 oz.	25.00
2609	Adventure	6 oz.	25.00
2611	Indy 500	6 oz.	37.50
2634	Human Cannon Ball	6 oz.	19.50
2635	Codebreaker	6 oz.	19.50
2636	Flag Capture	6 oz.	19.50
2637	Air-Sea Battle	6 oz.	19.50
2638	Hunt and Score	6 oz.	19.50
2639	Miniature Golf	6 oz.	19.50
2640	Hangman	6 oz.	18.75
2653	Tic Tac Toe	6 oz.	19.50
2654	Circus	6 oz.	19.50

CCS 32K STATIC RAM BOARD

Uses 2114, 250ns fully Static RAM's. Bank selectable in 8K blocks. Enable/Disable on power up or Reset. Compatible with North Star, Alpha Micro, Cromeco, etc. Also front panel compatible, addressable in 8K blocks. Selectable wait state. Wt. 1 lb.

Cat No. 2644 Assembled & Tested **$710.00**

CCS 64K DYNAMIC RAM BOARD

Check the features, then compare the price of this memory board from CCS. Uses low power 4116 Dynamic RAM's, Bank Selectable in 16K blocks, bank Enable/Disable on power-up or reset, "fail safe" modes for transparent refresh on 8080 or Z-80, 4mhz operation, phantom line capability and compatible with front panel systems. Wt. 12 oz.

Cat No. 2647 Assembled & Tested **$699**

CCS Z-80 CPU BOARD

California Computer Systems has done it again! An all new Z-80 CPU board loaded with such great features as S-100/Altair/Imsai compatibility. Power-on jump to any Memory address, selectable Z-80 monitor ROM, selectable MI wait states, full handshake, auto band (2 baud-56K baud) selection, selectable port address, separate baud rate oscillator and on-board RS-232 100% disable option serial port. This board also boasts front panel support compatabililty, Z-80 refresh capability, Z-80 NMI capability, phantom line capability, Z-80 interrupt capability and status valid on Data Lines during psync. Wt. 3 lbs.

Cat No. 2646 **$299**

CCS 2422 DISK CONTROLLER

This disk controller is equipped with a soft sector format, will support single and double density formats, supports up to four 5¼" and/or 8" single or double sided drives. It has ROM controlled addressing for I/O mapped and/or (optional) memory mapped operation, fast seek capability for voice-coil type drive, adjustable write precompensation, digital phase-locked data separator, selectable auto-wait on Data or Control port and on-board 2K Byte Boot/program ROM (2716). A copy of CP/M 2.2 is included.

Cat No. 2645 **$399**

LEEDEX VIDEO 100 12" MONITOR
$139

- *Compatible with many home computers, including TRS-80 (no interfacing required)*
- *High resolution*

One of the most popular low cost, high resolution monitors available, comparable with units costing much more! Utilizes standard composite video input, which eliminates the need for an RF modulator. An extremely sharp and stable picture in a rugged, attractive package. 12MHz video bandwidth +/− 3db with 750 ohm input impedance.

Cat No. 1204	Video 100 monitor	18 lbs.	$139.00
Cat No. 1937	TRS-80/LEEDEX cable kit	6 oz.	$ 3.00



LEEDEX VIDEO 100-80 MONITOR

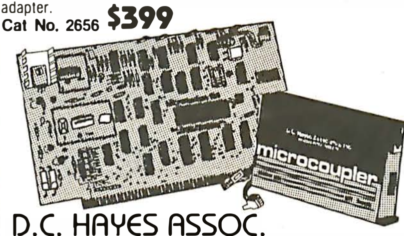
Features industrial-grade metal cabinet with built-in disk mounting capability, and space for an 11 x 14" PC board. Solid State circuitry assures a sharp, stable picture. Front panel controls include power, contrast, horizontal and vertical hold, and brightness. Wt 20 lbs.

Cat No. 2374 **$199**

D.C. HAYES ASSOC. MICROMODEM 100

The Micromodem 100 is a complete data communications system for S-100 microcomputers. It combines the capabilities of a serial interface card and an acoustic coupler with the addition of a programmable automatic dialing and answer. Includes 16 bit machines and a 4 MHz processors, two software selectable baud rates, 300 baud and a jumper selectable speed from 45 to 300 baud. Direct connect microcoupler through your local telephone company system, auto answer/auto call. Software compatible with D.C. Hayes 80-103A data communications adapter.

Cat No. 2656 **$399**



D.C. HAYES ASSOC. MICROMODEM II For APPLE II

This is a sophisticated computer to computer or terminal to computer modem for use in Apple II personal or small business systems. It provides all the capabilities of a Serial interface card and an acoustic coupler with the addition of programmable automatic dialing and answer. On board ROM firmware provides for remote console, terminal mode and simplified implementation of more sophisticated applications with BASIC programs. The Micromodem II comes with the "Microcoupler", an exclusive new device that allows you to connect your Apple II directly to a modular jack provided by your local telephone Co.

Cat No. 2655 **$379**

SEND FOR FREE FLYER FEATURING . . .

Page after page of impressive, state-of-the-art products. Included in flyer are computers, terminals, disk-drives, printers and many more electronics peripherals that can add dimension to your personal computing. We also stock computerized games and toys, application boards, a large selection of comprehensive software, electronics books, electronics parts, integrated circuits, P.C. & soldering accessories and much, much more.

For all your electronics' or hobbyist's needs, circle our Reader Service number or write/phone us for your free illustrated flyer today!

HOW TO ORDER

Minimum Order $15.00. Order by phone, mail, or at our retail stores. Pay by check, Mastercharge, Visa or C.O.D. Please include expiration date with charge card orders. U.S. $$ only. Include phone number and magazine issue you are ordering from. Add $1.25 for C.O.D. and shipping charges from rates below.

Shipping Rates: U.S.A.
Ground: Add $2.25 for first 2 lbs. and 40¢ each addt'l. lb.
Air: Add $3.25 for first 2 lbs. and 70c each addt'l. lb.

Shipping Rates: Foreign
Ground: Add $3.00 for first 2 lbs. and 60c each addt'l. lb.
Air: Add $11.25 for first 2 lbs. and $5.00 each addt'l. lb.

Prices Valid through month of issue. Not responsible for typographical errors. Some items subject to prior sale or quantity limits. 120 day guaranteed satisfaction.
Exception: Partially assembled kits, abuse or misuse.

HOBBYWORLD® ELECTRONICS INC.

19511 BUSINESS CTR. DR. DEPT B9 NORTHRIDGE, CALIF 91324

Circle 339 on inquiry card.

Accessories and Software

for Apple, Commodore, TRS-80, Atari

Call TOLL FREE - 800-421-0347







ACCESSORIES

- CORVUS 10 MEGABYTE DISK DRIVE $4849
- PASCAL LANGUAGE SYSTEM C
- GRAPHICS INPUT TABLET .... A
- DISK II with CONTROLLER CARD L
- DISK II without controller L
- APPLE SOFT II FIRMWARE CARD
- INTEGER FIRMWARE CARD
- PARALLEL INTERFACE CARD
- SERIAL INTERFACE CARD
- COMMUNICATIONS CARD
- SERIAL INTERFACE CARD
- SUP-R-MOD RF TV MODULATOR 24
- SUP-R-TERM 80 col. CARD 348
- DAN PAYMAR Lower case kit 44
- SVA 8" DISK CONTROLLER CARD 348
- CCS ARITHMETIC PROCESSOR CARD . 348
- CLOCK/CALENDAR CARD 238
- INTROL X-10 SYSTEM 238
- SUPER TALKER SPEECH SYNTHISIZER 258
- ROMPLUS CARD w/KEYBD. FLTR. 178
- HEURISTICS SPEECHLINK 2000 224
- DC HAYES MICROMODEM II 334
- ALF MUSIC SYNTHISIZER 244
- SSM A10 CARD (KIT) 128
- SSM A10 CARD (ASSEMBLED) 189
- NOVATION CAT MODE M 158
- CCS GPIB IEEE INTERFACE 268
- MICROSOFT Z-80 SOFT CARD w/CP/M 348
- MICROWORKS DS--65 DIGISECTOR ... 348
- ROMWRITER 158
- SYMTEC LIGHT PEN CARD 228
- CCS PROGRAMMABLE TIMER MODULE 158
- CENTRONICS PRINTER INT. CARD 189
- SLIENTYPE PRINTER w/INT. CARD 528

APPLE SOFTWARE

- 3 MILE ISLAND, Muse 39.95
- 3-D ANIMATION-D, Programma Intl 24.95
- 3D ANIMATION, Sub Logic 55.00
- 3D GRAPHICS, Programma Intl 24.95
- 6502 ASSEMBLER, Personal S/W 24.95
- 8080 SIMULATIONS, Sybex 19.95
- ABBS, Periph Unltd 49.95
- ACCOUNTING ASSISTANT, Instant S/W 7.95
- ADDRESS BOOK, Muse 49.95
- ADVENTURE 3 & 4, Creative Comp 24.95
- ADVENTURE-D, Microsoft 29.95
- ADVENTURE-D, Programma Intl 21.95
- ADVENTURELAND, Creative Comp 14.95
- ALIEN LANDER, Sierra Software 24.95
- AMPERSORT 2, Programma Intl 15.95
- ANALYSIS 1, Galaxy 49.95
- ANALYST, Programma Intl 15.95
- APMAIL, Programma Intl 19.95
- APPILOT, Muse 49.95
- APPLE DOC, Sowest Data 24.95
- APPLE LISNER, Softape 19.95
- APPLE PIE-D, Programm Intl 24.95
- APPLE PILOT, Programma Intl 24.95
- APPLE PLANET, Programma Intl 24.95
- APPLE POST, Apple 50.00
- APPLE WRITER, Apple 75.00
- APPLEFORTH, Programma Intl 49.95
- APPLESOFT OPTIMIZER, Programma . 19.95
- APPLESOFT PLUS, Programma Intl 24.95
- APPLETALKER, Softape 15.95
- APPLEWORLD, United Software 59.95
- ASSEM LANG DEVELOPMENT, Hayden 39.95
- ASSEMBLER, Microproducts 39.95
- ASTEROIDS, Quality Softwr 19.95
- ASTROAPPLE, Software Factry 15.00
- AUTOCHECKERS, Programma Intl 15.95
- B I T S, Periph Unltd 34.95
- BABBLE, Software Factry 15.00
- BASEBALL, Muse 14.95
- BATTLESHIP COMMAND, Quality Sftw 14.95
- BATTLESTAR 1, Programma Intl 15.95
- BAZOOKA, Programma Intl 15.95
- BEST OF BISHOP, Softape 39.95
- BLOCKADE, Personal S/W 14.95
- BOWLING, Apple 15.00
- BRAIN GAMES, Creative Comp 7.95
- BRIDGE CHALLENGER, Personal S/W . 14.95
- BRIGHT PEN, Softape 34.95
- BUSINESS/FINANCE, Programma Intl .. 19.95
- CAI PROGRAMS-D, Creative Comp 14.95
- CASTLE ADVENTURE, Programma Intl. 15.95
- CCA DATA MGMT., Personal S/W 100.00
- CHECKBOOK, Apple 20.00
- CHECKBOOK, Programma Intl 34.95
- CHECKBOOK KING-C, Personal S/W .. 19.95
- CHECKER KING-C, Personal S/W 19.95
- CHECKER KING-D, Personal S/W 24.95
- CLOWNS & BALLOONS, Programma .. 15.95
- COMPUMATH, Edu Ware 39.95
- COMPUREAD, Edu Ware 24.95
- CRAPS, Softape 14.95
- DANS DISK, Periph Unltd 24.95
- DART ROOM, Programma Intl 15.95
- DATA MANAGER, Hayden 49.95
- DATABASE, Programma Intl 19.95
- DATABASE II, Programma Intl 29.95
- DATABASE MAIL-D, Programma Intl ... 29.95
- DATAMOVER, Apple 7.50
- DDU & SDC, Periph Unltd 39.95
- DEPTH CHARGE, Programma Intl 15.95
- DISASSEMBLER, Microproducts 34.95
- DOW JONES, Apple 50.00
- DUAL RACE, Systems Design 16.95
- EARTHQUEST-D, Programma Intl 19.95
- EASY WRITER, Personal Softwr. 99.95
- ELECTRIC CARD FILE, Softape 19.95
- ELECTRIC CRAYON, Muse 17.95
- ELEMENTARY MATH, Muse 39.95
- ENERGY AUDIT-C, Instant S/W 80.00
- ENGINEERING MATH-1, Hayden 14.95
- ESCAPE, Muse 12.95
- FASTGAMMON-C, Quality Softwr 19.95
- FASTGAMMON-D, Quality Softwr 24.95
- FILE HELPER, Baclan 49.00
- FINANCE PACK, Apple 25.00
- FLASH CARDS, Programma Intl 9.95
- FLIGHT SIMULATOR, Sub Logic 25.00
- FOOTBALL, Programma Intl 9.95
- FORM LETTER, Periph Unltd 24.95
- FORTE, Softape 19.95
- FORTH, Softape 49.95
- FRACAS-C, Quality Softwr 19.95
- FRACAS-D, Quality Softwr 24.95
- GALACTIC CONFLICT, Programma Intl 15.95
- GAME PLAY w/BASIC, Hayden 9.95
- GAME PLAY w/BASIC 2, Hayden 9.95
- GAME PLAY w/BASIC 3, Hayden 9.95
- GAMON GAMBLER-C, Personal S/W ... 19.95
- GAUNTLETS, Programma Intl 99.95
- GENERAL MATH-1, Hayden 14.95
- GLOBAL WAR, Muse 17.95
- GOBLINS, Programma Intl 15.95
- GRADE BOOK, Creative Corp 24.95
- GRAPHIC UTILITIES, Personal S/W 14.95
- HI RES ADVENTURE #1, On Line Syst . 24.95
- HIRES PLAYGROUND, Systems Design 24.95
- HOME ACCOUNTING-C, Programma Int 9.95
- HOME ACCOUNTING-D, Programma . 15.95
- HOUSEHOLD FINANCE, Programma .. 24.95
- HOUSEHOLD INVENT., Programma ... 24.95
- INSTANT LIBRARY-C, Softape 39.95
- INSTANT LIBRARY-D, Softape 39.95
- JOHN'S DEBUGGER, Broderick 35.00
- LASER TURRET, Programma Intl 9.95
- LISA, Programma Intl 34.95
- MAIL LIST, Periph Unltd 39.95
- MATCHWITS, Programma Intl 9.95
- MATH TUTOR 1, Instant S/W 7.95
- MATH TUTOR 2, Instant S/W 7.95
- MATRIX INVERT-C, System Design 13.95
- MAZE GAME, Muse 12.95
- MEMO CALENDAR, Periph Unltd 29.95
- MICRO INFOSYSTEM, Muse 99.95
- MICROCHESS, Personal S/W 19.95
- MICROCHESS-C, Apple 20.00
- MICROCHESS-D, Apple 25.00
- MICROGAMMON, Softape 14.95
- MINI LEDGER, Programma Intl 59.95
- MINI LEDGER-D, Programma Intl 59.95
- MISSION IMPOSSIBLE, Creative Comp 14.95
- MONITOR-D, Programma Intl 49.95
- MORTGAGE, Instant S/W 7.95
- MULTIPLE REGRESSION, Systems D .. 24.95
- ORIGINAL ADVENTURE-D, Creative Cp 24.95
- OUTDOOR GAMES, Creative Comp 14.95
- P A D, Datasoft 19.50
- P I T S, Periph Unltd 30.00
- P U M P, Periph Unltd 25.00
- PARCHESI, Programma Intl 6.95
- PERCEPTION I,II,III, Edu Ware 19.95
- PERPUTUAL CALENDAR, Programma . 9.95
- PHASOR ZAP, Programma Intl 15.95
- PINBALL, Programma Intl 15.95
- PIRATE ADVENTURE, Creative Comp .. 14.95
- POWER EDITOR, Programma Intl 15.95
- PRO GOLF, Softape 12.95
- PROGRAM EDITOR, Synergistic 40.00
- PROGRAMMING AID, Dakin 5 .... 39.95
- PROGRAMMING AID 2, Dakin 5 .... 49.95
- QUARTER HORSE RACE, Programma .. 6.95
- RAM TEST TAPE, Apple 7.50
- ROCKET PILOT, Softape 12.95
- SARGON 2, Hayden 27.00
- SARGON-C, Hayden 19.95
- SARGON-D, Hayden 34.95
- SCORPION ATTACK, Programma Intl .. 15.95
- SCREEN MACHINE, Softape 19.95
- SHELL GAMES, Apple 30.00
- SINGLE DISK COPY, Periph Unltd 19.95
- SKEETSHOOT, On Line 14.95
- SOLITAIRE, Programma Intl 15.95
- SPACE, Edu Ware 29.95
- SPACE II, Edu Ware 24.95
- SPACE SHUTTLE LANDING, Harvey ... 15.00
- SPACE/SPORTS GAMES, Creative Cp . 14.95
- SPYTREK, Programma Intl 15.95
- STAR WARS, Softape 12.95

IF YOU DON'T SEE IT HERE, CALL US. WE CARRY EVERYTHING FOR APPLE, TRS-80, COMMODORE, VECTOR, ATARI, SORCERER, TEXAS INSTRUMENTS, AND MORE!

- STATISTICS, Programma Intl 19.95
- STATISTICS, Edu Ware 17.95
- STIMULATING SIMULATIONS, Personal S/W/ 14.95
- STOCK MARKET, RTR 79.95
- SUPER TEXT, Muse 100.00
- SUPERCHIP, Eclectic 100.00
- TALKING CALCULATOR, Softape 12.95
- TALKING DISK, Programma Intl 19.95
- TEXT EDITOR, Periph Unltd 59.95
- THE CASHIER, Apple 250.00
- THE CONTROLLER, Apple 625.00
- THE SOURCE, Periph Unltd 25.00
- THE SOURCE, TCA 29.95
- THE TYPESETTER, Programma Intl 29.95
- TIC TAC TALKER, Softape 19.95
- TIME CLOCK, Programma Intl 6.95
- TIME TREK, Personal S/W 14.95
- TINY PASCAL, Programma Intl 49.95
- TRAPSHOOT, On Line 19.95
- TRIVIA][, Programma Intl 15.95
- TURF ANALYSIS, Systems Design 21.95
- TYPE TRAINER, Programma Intl 15.95
- TYPING TUTOR, Microsoft 14.95
- UNCLE SAM, Muse 12.95
- UPDATES, Periph Unltd 39.95
- VISICALC, Personal S/W 150.00
- VOYAGER EXCURSION, Programma .. 15.95
- WEIGHT PLOTTER, Programma Intl ... 19.95
- WHATSIT, Computerheadgr 125.00
- WINDFALL, Edu Ware 19.95

PET ACCESSORIES

- Commodore Dual Floppy Disk Drive $1,285.00
- Second Cassette—from Commodore ... 95.00
- Commodore PET Service Kit 30.00
- Beeper—Tells when tape is loaded 24.95
- Petunia—Play music from PET 29.95
- Video Buffer—Attach another CRT 29.95
- Combo—Petunia abd Video Buffer 49.95
- TNW Bi-Dir RS-232 printer S-face 229.00
- KIM A (A Single Board Computer from Commodore) 179.00
- CMB 8050 Dual Drive Floppy Disk .. 1,695.00
- CBM Modem 395.00
- CBM Voice Synthesizer 395.00
- PET TO IEEE Cable 39.95
- IEEE TO IEEE Cable 49.95
- KIM1 & Power Supply Package Special 200.00

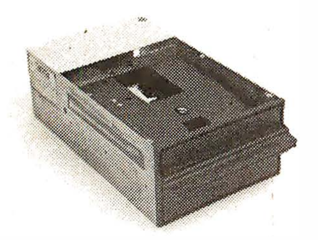
PET SOFTWARE

- ACTION, Soundware $9.95
- ACTION GAMES, Creative Comp 7.95
- ALPHABET, Commodore 9.95
- AWARI, Programma Intl 9.95
- BACKGAMMON, Commodore 9.95
- BACKGAMMON, Hayden 10.95
- BASIC BASIC, Commodore 14.95
- BASIC FINANCE, Commodore 24.95
- BASIC MATH, Commodore 29.95
- BATTER UP, Hayden 10.95
- BATTLESHIP, Programma Intl 9.95
- BLACKJACK, Commodore 9.95
- BLOCKADE, Programma Intl 9.95
- BLOCKADE, Personal S/W 14.95
- BOWLING, Commodore 9.95
- BRIDGE CHALLENGER, Personal S/W . 14.95
- CHASE, Programma Intl 9.95
- CHECKBOOK, Commodore 24.95
- CHECKER KING, Personal S/W 19.95
- CHECKERS, Instant S/W 7.95
- COSTING, Commodore 19.95
- DATA BASE UTILITY, Commodore 24.95
- DEPTH CHARGE, Programma Intl 9.95
- DIET PLAN, Commodore 14.95
- DISASSEMBLER, Commodore 24.95
- DOW JONES, Instant S/W 7.95
- DUNGEON OF DEATH, Instant S/W 7.95
- GALAXY GAMES, Commodore 9.95
- GAME PLAY w/BASIC, Hayden 9.95
- GAME PLAY w/BASIC 2, Hayden 9.95
- GAME PLAY w/BASIC 3, Hayden 9.95
- GRAPHIC GAMES #1, Creative Comp ... 7.95
- GRAPHIC GAMES #2, Creative Comp ... 7.95
- GRAPHIC UTILITIES, Personal S/W 14.95
- GRAPHICS, Commodore 9.95
- GUESS A SENTENCE, Commodore 29.95
- HANDS ON BASIC, Commodore 14.95
- HOME ACCOUNTING, Programma Intl .. 9.95
- LOGIC #1, Creative Comp 7.95
- LOGIC #2, Creative Comp 7.95
- MACHINE LANGUAGE, Commodore 9.95
- MAYDAY, Hayden 9.95
- MICROBASEBALL, Hayden 9.95
- MICROCHESS, Personal S/W 19.95
- MONITOR, Programma Intl 6.95
- MORTGAGE, Instant S/W 7.95
- MORTGAGE, Commodore 14.95
- NUMBER GAMES, Creative Comp 7.95
- NUMBER REVERSAL, Commodore 9.95
- ON THE HOUSE, Commodore 9.95
- PERSONAL ACCT'NG., Programma Intl 19.95
- PET SHOW, Commodore 9.95
- PIRATE ADVENTURE, Creative Comp .. 14.95
- PROJECTILE MOTION, Commodore ... 19.95
- REALTY, Commodore 59.95
- RHYMING, Commodore 9.95
- SERIES/PARALLEL, Commodore 19.95
- SLOT MACHINE, Programma Intl 6.95
- SOME COMMON BASIC PROB-D, Osborne & Assoc 9.95
- SPACETALK, Commodore 9.95
- SPACETREK, Commodore 9.95
- STATISTICS, Commodore 29.95
- STOCK PROTFOLIO, Commodore 24.95
- STRATHCLYDE BASIC, Commodore ... 14.95
- TARGET PONG, Commodore 9.95
- TIME TREK, Personal S/W 14.95
- TREK X, Instant S/W 7.95
- TURF & TARGET, Instant S/W 7.95
- USER PROT COOKBOOK, Commodore . 9.95
- UTILITIES, Smithware 7.95
- VIDEO CHECKERS, Compuquote 14.95
- WORD PROCESSING 2, Commodore .. 99.95
- WORD PROCESSING 3, Commodore . 199.95
- WORLD CLOCK, Commodore 9.95

MICRO BUSINESS WORLD™
15818 Hawthorne Blvd.
Lawndale, CA 90260 (213) 371-1660

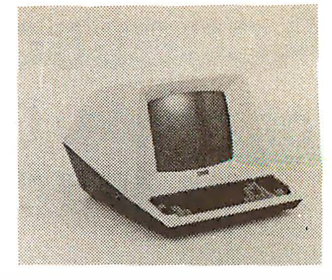
CALL US TOLL FREE FOR NEW CATALOG OF ACCESSORIES & SOFTWARE 800-421-0347

Circle 340 on inquiry card.



Qume Datatrak 8

Double sided floppy with NO HEADACHES. Although many think this an impossibility, seeing is believing, and this drive is really something! Shugart compatible, fully optioned, reliable, and rapidly becoming the standard in double-sided diskdom.
$599. Two/$549.



Electrolabs' Monthly Special!!!

TELEVIDEO 912C $699
TELEVIDEO 920C 799
Features typewriter keyboard, microprocessor controls, Upper/lower case, adjustable baud rates (75-9600 baud), special function keys, much much more.
Second page memory option $29.00

Siemens FDD 100-8D

Single sided 8" floppy drive, the latest & greatest revision. Features double density plus much more. An extremely reliable drive $439 2/$409

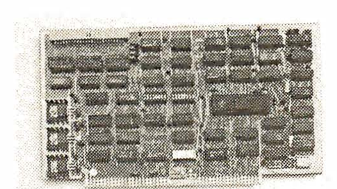
Hard sector option kit...	$9.95
Data separator option kit...	$9.95

The following 5¼" mini-floppies share most features with their 8" cousins, so without further ado. . .

Siemens FDD 100-5D............	$279.
Qume Datatrak 5 (double sided)....	399.
BASF Mini mini................	279.
SA 400......................	299.

All the above mini-floppies are fully SA400 compatible.

Manuals for all drives are $10, refundable against future purchase of drives. Also, all 8" drives can be ordered with 220 v/50 hz for worldwide use.



Disk controllers

Delta Products double density	$349
Micromation doubler	439
Tarbell single density, A & T	225
Tarbell single density, kit	184
Tarbell double density, DMA	425
Sorrento Valley 8" single density for Apple	375

Data Display Monitors

used 12" Sylvania monitors. Composite video, 12 MHz, 120 VAC. with new P-39 or P-4 tube, $79, used tube $59, OEM style (without case), subtract $12. U-fix model, 10/$300.

Hard Disk

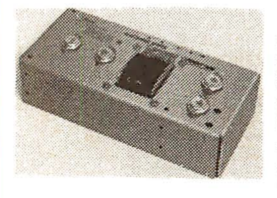
CII HB 10 MBY fully REMOVEABLE cartridge drive. Complete with controller, personality card, media, power supply, cabling, connectors and documentation. Highlighted by stylish & modern cabinetry. $6995.

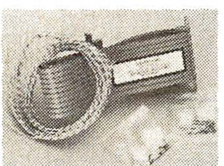
Shugart SA4008 20MBY fixed disk system. S-100, includes controller, power supply, and all that is necessary to run $6995.

4116 dynamic RAM, 16K **Bonanza!!**

Set of 8, 16K, for Apple, TRS-80, Exidy, Heath & more. 200 Ns., prime parts, at the unheard of $49/8.
Large discounts available for quantity & dealers (500 & up). Offer limited while supply lasts, as these will vanish quickly!!!

Accessories





Cable kits for 8" drives with 10' 50 cond. flat cable, power cable, and all connectors. Assembled if desired. One drive 27.50, two 33.95, three 38.95 for mini floppies (34 cond): one 24,95, two, 29.95

CP-206 Power-one power supply. Powers two drives more than adequately, top quality. 2.8A/24V, 2.5A/5V, .5A/-5V................ $99.

mini-floppy power supply $79

Electrolabs

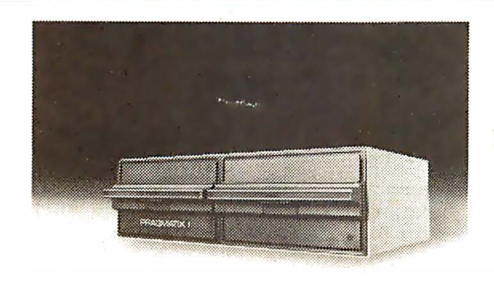
POB 4436, Stanford, CA 94305
415-321-5601 800-227-8266
Telex: 345567 (Electrolab Pla)
Visa MC Am. Exp.

Media

8" ...$39.99 SS/SD
8" ...$49.00 SS/DD
8" ...$55.00 DS/SD
8" ...$59.00 DS/DD
5¼" $34.95 SS
5¼" $59.00 DS
Verbatim, Memorex, Scotch, or equivalent name brand
Special Introductory Offer!!!
Wabash 8" diskettes $29.00 SS
$39.00 DS
Price is cheap, but they run like champs!!!!

Diskette head cleaning kit for 5¼" or 8" $28.75 includes everything for 1 drive for 1 year. Alignment Diskette for Floppy Drives.......... $39.00





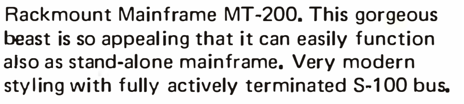
PRAGMATIX 1

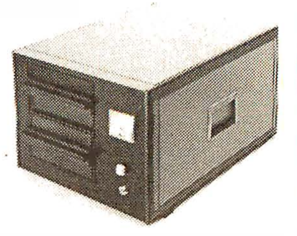
Incredible!! — Two 8" Shugart compatible single sided floppy disk drives (double density), CP-206 power supply, in handsome color coordinated cabinet, with full cabling, connectors, and documentation, plus one box diskettes!!! All for an unprecedented $1295. Up to one MBY of storage.

with Qume Datatrak 8" double-sided drive $1695



ENCLOSURES





Rackmount Mainframe MT-200. This gorgeous beast is so appealing that it can easily function also as stand-alone mainframe. Very modern styling with fully actively terminated S-100 bus.

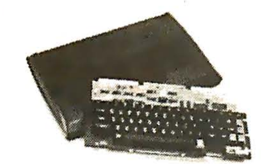
With two 8" single-sided disk drives... $1899.
With two 8" double sided disk drives in place of single-sided variety............. $2499.

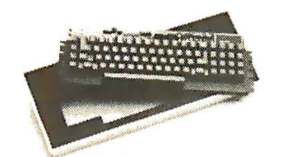
Desktop Mainframe MT-100. Contemporary styling, a handsome cabinet coated with durable epoxy finish colors (blue, beige, off-white & silver). Easy to fit into an office environment. The proper way to start your system.

Above plus two 8" single sided disk drives.............. $1599.
Above with two 8" double sided disk drives in place of single-sided variety .... $2199.

$25 min. order. Calif. residents add 6% sales tax. Orders under $75, add 5% shipping and handling, over $75 add 2.5%. All pricing subject to change without notice.

Circle 341 on inquiry card.





Keyboard Special 2 !!

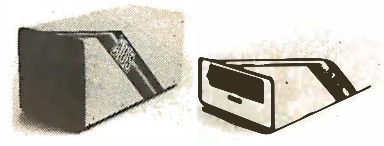
Keytronics 1660	$149.00
Hard Plastic enclosure	49.00
BOTH only	$152.00

Keyboard Special 1 !!

CHERRY "PRO" Keyboard	$119.00
Streamlined Custom Enclosure	34.95
BOTH only	$134.95

Disk Subsystem

Matchmaker Technology
TURNKEY DISK SUBSYSTEMS



APPLE ...... Single density disk controller. Expanded Apple DOS

TRS-80 .... Single or double density. Expansion interface necessary. Space for 48K dynamic RAM on controller card RS232 port

SORCERER .. Full RS-232 Interface. One S-100 slot for memory expansion. Single or double density

All above units come as follows: Complete, assembled and tested, with two 8" floppy disk drives (Apple available in one drive model). Includes all cabling, connectors and documentation in a stunning color coordinated cabinet with power supply. Ready to go, plug in and run!!!

* * *

When ordering specify single or double sided drives

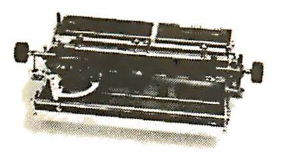
* * *

Software available for above disk add-ons

* * *

TRS-80 & Sorcerer operate on all CP/M compatible software

Daisy Wheel Printers



NEC Spinwriter 5510/2	$2899
NEC Spinwriter 5520/2	call
NEC Spinwriter 5530/2	for prices

ESAT 200B

BI-LINGUAL 80x24
Communicating Terminal

Scrolling, full cursor, bell, 8x8 matrix, 110-19,200 baud, Dual Front Applications. Arabic & Hebrew, Multilingual Data Entry Forms Drawing, Music, & Switchyards.

Alone	$279.
with Cherry Pro keyboard & custom metal case	$399.

Peripheral Sale!!

Hiplot Plotter	$875.
Hipad Digitizer	715.
IDS 440 Paper tiger	899.
SD Expandoram II (A&T, 64K)	560.
Imsai 65K dynamic RAM III	399.
DC Hayes Micromodem 100 ..	399.
Super switcher power for hard disk & more	349.

DC Hayes Micromodem 11 (for apple) $344
DC Hayes Micromodem 100 $349

Qume S/5

Sprint 5/45 RO	$2699
Sprint 5/55 RO	2829
Sprint 5/45 KSR	3029
Sprint 5/55 KSR	3159
Forms Tractor	$210
Pinfeed platen	155
paper guide	30
paper basket	50

many print wheels, ribbons, & more available

Qume Sprint 3\45

(requires self assembly)

printer mechanism	$1499
power supply	349
combination special	1699
cases	200
S-100 interface card	149

Circle 341 for Electrolabs

Electrolabs
POB 4436, Stanford, CA 94305
415-321-5601 800-227-8266
Telex: 345567 (Electrolab Pla)
Visa MC Am. Exp.

SOFTWARE LABS

LSI·11 Z·80 8080 8085 6502

735 LOMA VERDE, PALO ALTO, CA. 94303 **PHONE: 415 493·8186**

Database Management Systems

HDBS A hierarchical Database Management System featuring fixed length records, read/write protection at file level and one to many set relationships.

Z-80 Optimized	250.00
8080 Optimized	325.00
6502 Optimized	325.00

MDBS A large computer DBMS with hierarchical and full network data structures (CODASYL Oriented). Explicit representation of one to one, one to many, many to one and many to many sets. Routines are callable from BASIC, PASCAL' COBOL or Machine Language.

Z-80 Optimized	750.00
8080 Optimized	825.00
6502 Optimized	825.00

Communications

BISYNC-80/3780 A full function IBM 2780/3780 emulator that provides one of the most widely used communications protocols. 550.00

BISYNC-80/HASP A full function Hasp Multi-leaving Workstation package. 800.00

BISYNC-80/ASYNC An asynchronous communications package that uses the full error correcting BISYNC protocol. 95.00

BISYNC-80/3270 A full function IBM 3275 or 3271/3277 terminal emulator that converts a "dumb" terminal into a very smart one. 550.00

Multiple License Pricing
- Upon Inquiry -

*LSI-11, PDP-11 TM DEC, UNIX TM Western Electric, CP/M TM Digital Research

High Level Languages

8080, 8085, Z-80 (Under OS-1 or CP/M)

BASIC

Microsoft Compiler	395.00
Microsoft "BASIC 80"	350.00

FORTRAN

Microsoft "FORTRAN 80" (Includes MACRO 80)	500.00

COBOL

Microsoft "COBOL 80"	750.00

"C"

Whitesmith's "C"	600.00

PL/1

Digital Research's PL/1	500.00

PASCAL

M.T. Compiler	250.00

Z-80 Optimized (Under OS-1 or CP/M)

COBOL

R-M Z-80 COBOL ANSI '74	750.00

LSI-11*/PDP-11* Under RT-11 or RSTS

COBOL - ANSI '74 Introducing:

RJ-11 Compiler	1750.00

Applications in COBOL '74

Available in R-M COBOL, COBOL 80 and RJ-11. (Source Included)

General Ledger	995.00
Accounts Receivable	995.00
Accounts Payable	995.00
Inventory Control	995.00
Order Entry/Invoicing	995.00
COMPLETE LEGAL	4200.00
COMPLETE DENTAL	4200.00

Why COBOL?
It's portable (ANSI '74) it's universal!

OPERATING SYSTEMS

Z-80 Optimized

OS-1™ A breakthrough in microcomputer software from Electrolabs! UNIX*-like OS with virtual I/O, bank-select memory control to 16 MBY and optional memory protection! Totally compatible with all CP/M programs. You will be amazed at the difference! Excellent brochure available. Includes editor, linker-loader, debugger, and one year update. **249.00**

8080, 8085 & Z-80

CP/M Version 2.2	150.00
Manuals only	25.00

CP/M - MCZ Version 2.2. Runs on **ZILOG MCZ** and **PDS-8000** systems.

Only from Software Labs!	200.00
Manuals only	35.00

OUR CATALOGUE

Software
Supplies
Media
Storage Equipment
Publications
- Upon Request -

Circle 400 for Software Labs

TO ORDER

*Price of manuals applied against software purchase.

By Mail: Send check or money order (or P.O. from rated or institutional customers).

By Phone: Use Master Charge or Visa No.

Important Note: Please specify complete system hardware and software configuration with each order.

New Summer 1980
SEND FOR OUR FREE CATALOG

CompuMart lets you put 'em on trial

CompuMart has been selling computers by mail since 1971. Our thousands of satisfied customers rely on CompuMart for services not generally available from the others. Namely:

- Product Selection/Each product advertised by CompuMart has been evaluated by our in-house staff for best price, performance, and supplier reliability
- Return Privilege/After receipt of our products, you are protected by CompuMart's exclusive, 10-day return privi-ledge- good for all products except software.
- Support/Our Customer Service Dept. and expert technicians are always there to assist you by phone or at CompuMart's outlets. Our knowledgeable phone sales force can provide you with detailed information and complete product specifications.
- Phone Ordering/For added convenience, CompuMart maintains a toll-free ordering number. 1-800-343-5504.

with 10 day free return

Computers

Apple Computer—We have a complete inventory of Apple computers, peripherals and software—In stock for immediate delivery—Call us for prices.





COMMODORE

Buy Direct from the largest Commodore dealer in the country, and the very first Commodore distributor in the U.S. Buy from the experts- Buy from CompuMart.

Commodore—We have everything that Commodore manufactures. In stock for Immediate Delivery! Computers from the new 80 column CBM to the single board KIM-1. Accessories from the new CBM Voice Synthesizer to the Beeper. Call CompuMart now for low prices and special deals.

ATARI 800 PERSONAL COMPUTER SYSTEM

ATARI

INTRODUCTORY SPECIALES

To celebrate our commitment to Atari, we are offering the following Atari Specials: note (You must buy an Atari)

(1) Buy additional memory for your computer, 8K or 16K, and we will double the amount of memory FREE! (A potenial savings of $200)
(2) Buy the Atari 800 Computer and take $100 off the purchase price of the Atari 810 Disk Drive or the Atari 820 printer

Comes with:
- 800 Operator's Manual
- 16K RAM Memory Module™
- 10K ROM Operating System
- Power Supply
- TV Switch Box

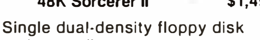
PERIPHERALS
Atari 800 Printer **$599.95**
Atari 810 Disk Drive **$699.95**
Atari 410 Program Recorder **$89.95**
Atari 800 Computer System **SUPER SALE $979**

COMPUMART NOW OFFERS THE ENTIRE DEC LSI-11 PRODUCT LINE. CALL FOR PRICES & DELIVERY.

Texas Instruments TI-99/4 Home Computer
Save $300 on this 16-Bit computer with monitor

TI-99/4 w/Monitor	**$825**
TI-99/4 w/o Monitor	**$725**

FREE 9" Sanyo Monitor with purchase of any Exidy Sorcerer Computer.
$159 VALUE!



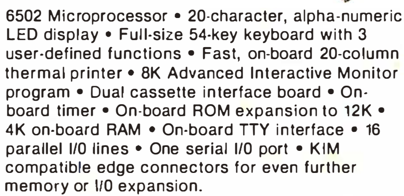
The Magicians Have Done It Again with the Sorcerer II . . . Expandable to 48K! - Greatly enhanced word processing capabilities.

16K Sorcerer II	**$1,245**
32K Sorcerer II	**$1,395**
48K Sorcerer II	**$1,495**

Single dual-density floppy disk and controller	**$1,100**
Second Drive	**$760**
S-100 Expansion Unit	**$419**
Video Display Disk	**$2,895**
Micromodem 100 from D.C. Hayes	**$379**

ROCKWELL AIM 65

THE SINGLE BOARD DEVELOPMENT SYSTEM



6502 Microprocessor • 20-character, alpha-numeric LED display • Full-size 54-key keyboard with 3 user-defined functions • Fast, on-board 20-column thermal printer • 8K Advanced Interactive Monitor program • Dual cassette interface board • On-board timer • On-board ROM expansion to 12K • 4K on-board RAM • On-board TTY interface • 16 parallel I/0 lines • One serial I/0 port • KIM compatible edge connectors for even further memory or I/0 expansion.

The CompuMart AIM System combines all of our options for the AIM to give you the capabilities of development systems costing 5 to 10 times as much. This system includes a 4K AIM 65 with BASIC and Assembler, and MTU power supply, a Sanyo tape recorder and an EGI Enclosure for the AIM.

CompuMart Aim System **$850.00**
4K AIM-65 .... **$515.00**
Paper for the AIM **$4.75**

SEE OUR AD ON PAGE 316

Zenith Z-89
The All-In-One-Computer
This is the famous computer system which takes up no more space than a terminal alone. The 12" screen is beautiful and lends itself perfectly to professional applications thanks to its 25 lines of 80 characters. We know of no other computer which gives you this many features at such a low price.

Zenith 48K Z-89 Dual Port	List $2,895
CompuMart	**$2,695**
Z-19 Smart Video Terminal	List $995
CompuMart	**$895**



Introducing the HP-85 $3,250
Hewlett-Packard's Personal Computer for Industry. This extremely portable computer features extended BASIC to solve your problems quickly and efficiently along with an advanced graphics system to enhance communication.

New from Novation! -D-CAT
The only direct modem that's FCC approved for hardset jack connection with any modular phone. **$199**

NOVATION CAT™
ACCOUSTIC MODEM
- Answer Originate
- 300 Baud
- Bell 108
- Low Profile Design

Looks good, works great! $179.00

Circle 342 on inquiry card.

Terminals



Televideo 912C
820 × 24—Lower case descenders. Teletype or telewriter keyboard. 110/220 VAC. 50 to 19.2K Baud Item entry pad. Great looking and no fan noise. $950

Televideo 920C
Similar to the TV 912 but has programmable function keys across top. Excellent for text editing. $1,030

We've got the following Lear Siegler Terminals In Stock at prices too low to print—**Call** for quotes.

ADM-3A Industries favorite dumb terminal for some very smart reasons.

ADM-3A.+ New from Lear Siegler. CALL!

ADM-31. The terminal that's too smart to be considered dumb.

ADM-42. Available with keyboard or without, semi-intelligent terminal offering tremendous user flexibility. The optional configurations are amazing.



Call for details.

HAZELTINE TERMINALS AT SPECTACULAR SAVINGS!

Hazeltine 1410.	List $850	**CompuMart $749**
Hazeltine 1420.	List $995	**CompuMart $895**
Hazeltine 1500.	List $1095	**CompuMart $995**
Hazeltine 1510.	List $1395	**CompuMart $1325**
Hazeltine 1520.	List $1585	**CompuMart $1485**
Hazeltine 1552.	List $1395	**CompuMart $1295**

Call CompuMart for complete specs and quantity discounts.

Calculators

A CALCULATOR, A SYSTEM, A WHOLE NEW STANDARD.

HEWLETT-PACKARD'S HP-41C

HP-41C Calculator $288.00

The System

Memory Modules. For storing programs or up to 2,000 lines of program memory $45.00

"Extra Smart" Card Reader. Records programs and data back onto blank mag-cards $199.00

The Printer. Upper and Lower case, High resolution plotting, Portable Thermal operation $355.00

Application Modules .... $45.00 EACH

Standard pac: Statistics, Math, Financial & Surveying

TI CALCULATORS -

Three of the finest from the first.
Programmable 59 . . . SUPER SALE $229

TI-58c Programmable Calculator (W/continuous memory) $104.00

TI Programmer $59.00

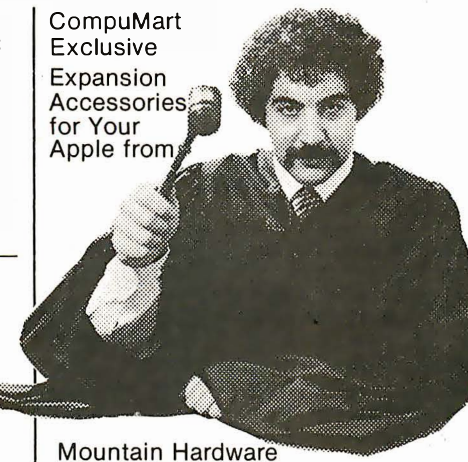
Add convenient versatile printing capabilities to your TI Programmable 58C or 59 calculator with the PC-100C thermal printer, plotter.

TI PC-100C $168.00

TI Talking Translator. The calculator actually speaks! $300.00



CompuMart Exclusive Expansion Accessories for Your Apple from



Mountain Hardware

For the ultimate in energy saving devices for your home get the BSR X-10. This system allows you to remotely control lights and electrical appliances in your home. The CompuMart package comes complete with Mountain Hardware software allowing your Apple to control home devices on a pre-determined schedule.

Introl/X-10 System $289

Let your Apple speak to you thru the amazing Supertalker. This device outputs high-quality human speech via a loudspeaker. Comes complete with the SuperTalker Peripheral Card, a microphone, loudspeaker, software, and two programs.

SuperTalker $299

The most advanced computerized composing system available — **The Music System — $545**

Give your Apple powerful new capabilities with the **ROMplus board — $199 w/keyboard filter.**

New From Microsoft
The Z-80 SoftCard
Just plug the Z-80 SoftCard into your Apple and instantly you will have more versatility than any other computer user. The Z-80 SoftCard package allows you to add FORTRAN, COBOL, and BASIC as versions are introduced over the next few months. With this card you can run any standard LP/M software and much more. Call us and we'll tell you exactly how much more.

Z-80 SoftCard, LP/M Operating System, and Microsoft Disk BASIC Interpreter — **$349**

Monitors

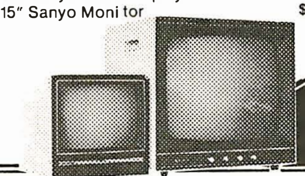
EXCLUSIVE from CompuMart!
Special Offer. Zenith Color Video Monitor for $379!

The perfect monitor for Apple, Atari and Texas Instruments owners.

NEW FROM SANYO — Four Great Monitors at Low CompuMart Prices.

Sanyo's new line of CRT data display monitors are specifically designed for the display of alpha-numeric or graphic data.

9" Sanyo Monitor	$159
12" Sanyo Monitor	$289
12" Sanyo Monitor with green screen	$299
13" Sanyo Color Display Monitor	$495
15" Sanyo Monitor	$269



Printers

Only the Best in Quality, Selection, and Service.

CompuMart STOCKS THE COMPLETE LINE OF MATROX PRODUCTS. CALL FOR SPECS.

The Paper Tiger Printer From Integral Data
Uses standard ⅞ inch roll paper and ribbon
40 characters per line
Speed: 40 characters per second
UL approved

High resolution dot matrix impact printer

Roar!

Standard features include: 4 character 8.3 to 16.5 cpi • 56 cps at 10 char. per in. • Selectable line spacing • 8 switch-selectable form sizes. The IDS Graphics Option for the Paper Tiger allows full dot pattern control and includes and expanded 2048-byte buffer (a 256-type buffer is standard).

IDS Paper Tiger Printer **$995**

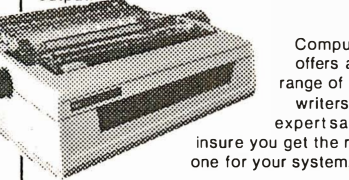
IDS Graphics Paper Tiger Printer **$1,094**

NEW! From Integral Data. The IDS 460.
We saw this new desktop printer at the NCC 80 and when we saw its features: Correspondence quality printing, High-resolution graphics capability, programmable print control functions, and automatic text justification—we knew that we had to offer this printer to our cost/features conscious customers $1,295

CENTRONICS PRINTERS
New! The incredible Model 737- Correspondence and Draft Quality Printing for Under $1,000. This is the first printer in its class to offer print quality suitable for text processing, plus the performance and application flexibility required for data processing. $995

Tractor Feed Printer- Centronics' Most Popular Model. Perfect for the needs of a small business sytesm. Recommended by Apple and Radio Shack. $1,079

NEC The First Name in Letter Quality Printers.
CompuMart offers beautiful print quality with NEC Spinwriter terminals. The Spinwriters, both KSR and RO versions, give unsurpassed hard copy output.



CompuMart offers a complete range of NEC Spinwriters—Call our expert salesforce to insure you get the right one for your system.

IMPORTANT ORDERING INFORMATION All orders must include 4% shipping and handling. Mass. residents add 5% sales tax; Mich. residents 4% for sales tax.

TO ORDER CALL: 800-343-5504
In Mass. call 1-617-491-2700

Phones open from 8:30 a.m. to 5:30 p.m. EST, Mon.-Fri. • P.O.'s accepted from D&B rated companies— shipment contingent upon receipt of signed purchase order • All prices are subject to change without notice • Most items in stock for immediate shipment— call for delivery quotation • In the Ann Arbor area? Our retail store is open 11:00 a.m. to 7:00 p.m. Tues.-Fri., 10:00 a.m. to 5:00 p.m. Saturdays (closed Sun. and Mon.)

COMPUMART
270 THIRD STREET, DEPT 109 CAMBRIDGE, MA. 02142



Member Computer Dealers Assoc.

We've had a reputation for dependability since 1971

Circle 342 on inquiry card.

page

PRE-CUT WIRE WRAP WIRE

Length	100/Bag	500/Bag	1K/Bag	Length	100/Bag	500/Bag	1K/Bag
2.5"	$1.25	$3.58	$ 6.19	6.5"	$1.92	$6.44	$11.81
3.0"	1.30	3.86	6.78	7.0"	1.99	6.76	12.44
3.5"	1.37	4.15	7.37	7.5"	2.08	7.07	13.09
4.0"	1.42	4.44	7.94	8.0"	2.14	7.38	13.73
4.5"	1.48	4.74	8.54	8.5"	2.18	7.69	14.36
5.0"	1.54	5.04	9.13	9.0"	2.24	8.11	15.01
5.5"	1.58	5.38	9.72	9.5"	2.30	8.32	15.65
6.0"	1.65	5.66	10.31	10.0"	2.39	8.71	16.28

Kynar precut wire. All lengths are overall, including 1" strip on each end. Colors and lengths cannot be mixed for quantity pricing. Choose from colors Red, Blue, Black, Yellow, White, Green, Orange, and Violet.

Kit No. 1			$9.95
250	3"	100	4½"
250	3½"	100	5"
100	4"	100	6"

Kit No. 2			$24.95
250	2½"	250	5"
500	3"	100	5½"
500	3½"	250	6"
500	4"	100	6½"
250	4½"	100	7"

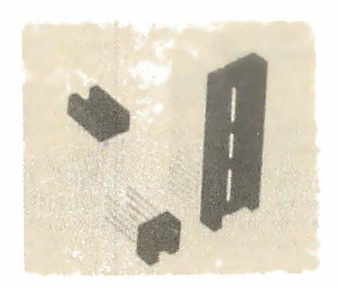
Kit No. 3			$32.95
500	2½"	500	4½"
500	3"	500	5"
500	3½"	500	5½"
500	4"	500	6"

Kit No. 4			$59.95
1000	2½"	1000	4½"
1000	3"	1000	5"
1000	3½"	1000	5"
1000	4"	1000	6"

★ ★ Truckload SALE ★ ★

FREE WIRE KIT

Kit #1 on orders over $50
Kit #3 on orders over $150
Kit #4 on orders over $250



RN WIRE WRAP IC SOCKETS

3-level Gold
Closed Entry
Design

*Sockets sold at these prices by the tube only.

Size	Quantity/Tube	Price ea.*	Price/Tube
08 pin	52	.39	**$20.28**
14	30	.46	**$13.80**
16	26	.50	**$13.00**
18	23	.68	**$15.64**
20	21	.85	**$17.85**
22	19	.92	**$17.48**
24	17	.94	**$15.98**
28	15	1.23	**$18.45**
40	10	1.60	**$16.00**

Above prices include gold up to $800/oz.

IDC CRIMP STYLE CONNECTORS

Card Edge Connectors

IDE 10	$3.25
IDE 20	$3.50
IDE 26	$4.05
IDE 34	$4.85
IDE 40	$5.65
IDE 50	$5.90

IDC Sockets

IDS 10	$1.25
IDS 20	2.02
IDS 26	2.65
IDS 34	3.50
IDS 40	4.05
IDS 50	5.06

Cable Plugs

IDP 14	1.25
IDP 16	1.40
IDP 24	2.25
IDP 40	3.65

DB25 Connectors

Male	$4.95
Female	$5.25

Right Angle Headers

Wire Wrap		Solder Tail	
IDH10WR	1.75	IDH10SR	.80
IDH20WR	2.75	IDH20SR	1.25
IDH26WR	3.60	IDH26SR	1.85
IDH34WR	4.15	IDS34SR	2.15
IDH40WR	4.90	IDH40SR	2.50
IDH50WR	6.15	IDH50SR	3.15

CABLE

	10 ft.	100 ft.
10	2.90	17.00
14	3.40	23.80
16	3.70	27.20
20	4.40	34.00
24	5.00	40.80
26	5.40	44.20
34	6.80	57.80
40	7.80	68.00
50	9.50	85.00

ORDERING INFORMATION

- Orders under $25 include $2 handling.
- All prepaid orders shipped UPS Ppd.
- Visa, MC & COD's charged shipping.
- All prices good through cover date.
- Most orders shipped next day.
- Byte must be mentioned to get sale prices.

Call or Write for 1980 Catalog:

★ IC Sockets
★ Vector Boards & Pins
★ Bishop Drafting Aids
★ OK Tools
★ RN IDC Crimp Connectors

page 135 E. Chestnut Street 5A, Monrovia, California 91016 Phone (213) 357-5005

Circle 343 on inquiry card.

California Digital

Post Office Box 3097 B • Torrance, California 90503

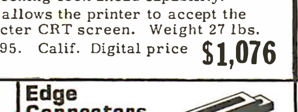


NEW from INTEGRAL DATA 460 Paper Tiger

**** All the features of the 440 and more ****

The 460 uses a dot matrix character formation technique in which the placement of the dots overlap both horizontally and vertically to achieve a correspondence-quality printing.
The printer's nine-wire print head uses staggered needle rows to create the vertically overlapping dots. The head is driven bi-directionally under microprocessor control by a stepper motor driven mechanism with logic-seeking look ahead capability.
Standard "Two-K Byte" buffer allows the printer to accept the entire content of a 1,920-character CRT screen. Weight 27 lbs.

suggested list price $1,295. Calif. Digital price **$1,076**



S-100 Mother Board

Quiet Buss $29.95
8803-18
18 slot
IMSAI

The Quiet Buss from California Industrial is quality engineered. No short cuts have been taken to produce this mother board. Active termination circuitry prevents noise and crosstalk. Manufactured from extra heavy FR-4 epoxy glass

TELETYPE® MODEL 43



4320 KEYBOARD

TTL ...... AAA	$ 950	
RS232 .... AAK	1050	plus shipping
Friction ... AAE	1100	
103 Modem AAB	1575	

WESTERN UNION ENCLOSURE

These enclosures were manufactured for Western Union by Universal Technology. The exact purpose of the product is still a mystery but the enclosure is ideally suited for an S-100 motherboard with shielded power supply.
Removable hood and plexiglas front make this enclosure an attractive home for any hobby product.
New surplus in factory boxes supplied with three 22/44 edge connectors; DB 25S communications connector; six foot grounded power cord and more. Inside dimensions: 19" x 10 1/2" x 6 7/8." Shipping weight 8 lbs.

$24.95

FREE PLASTIC LIBRARY CASE

with purchase of each box of .... Memorex mini-diskettes. $5 value.

$27 BOX of TEN

10 Boxes $24.95
100 Boxes $22.25
forty track

DISKETTES

DB25

	each	10+
male	$2.50	1.95
female	3.25	3.05
hood-2p	1.25	.98
Centronic	6.95	

BCD Thumbwheel Switch 1.95



Ten Position
Mfg. by Digiswitch
1 7/8" high 1/2" wide

Edge Connectors

GOLD 100 PIN IMSAI/ALTAIR

Imsai solder .125x.250	$2.95	3/$ 7.50
Imsai w/w .125 centers	$4.95	3/$13.00
Altair soldertail .140 row	$5.95	3/$15.00
SPECIALS		
22/44 Kim eyelet .156"	$1.95	3/$5.00
25/50 solder tab .156"	$1.09	3/$2.00
36/72 wide post w/w .156	$1.95	3/$5.00

COMPUTERS

Apple II standard 16K	$988
Apple Plus 16K	988
Atari 400	450
Atari 800	850
Texas Instruments 99/4	895.
Northstar Quad 32k Horizon	2995
Vector MZ	
Compucolor II Model 3	1395
Rockwell Aim 65 (1K)	375

CRT TERMINALS

ADDS Regent 25 (ten key pad)	850
ADDS Regent 40	1195
ADDS Regent 60	1495
Hazeltine 1420	850
Hazeltine 1500	995

MONITORS

Sanyo 9" black & white monitor	179
Leedex Video 100 12"	125
Leedex Video 100-80 12"	179

PRINTERS

IDS440G Tiger with Graphics	$995
Printronix P-300 (300 LPM)	4900
Printronix P-600	
Teletype Model 43 (RS232)	1150
Teletype Model 40 (132 col.)	
NEC Spinwriter 5510 R/O	2595
Texas Instruments 810	1650
Centronics 730 friction	695
Centronics 779-2 tractor	995
Centronics 704	1950
Anadex DP8000	895
Anadex DP9500	
Anadex DP9501	
Diablo 1540 R/O plastic wheel	2750
Diablo 1540 KSR plastic wheel	3150

MODEMS

Universal Data Systems LP300 Direct coupled * FCC Approved powered from phone line.	169
Novation Cat Acoustic	169

DISK DRIVES

Shugart SA800R 8" floppy	$449
Shugart SA801R 8" hard sec.	479
Lobo / Two Shugart 801's with power supply and enclosure	1195
One Shugart 801 with power supply and enclosure	795
Lobo hard drive for Apple 10 meg/byte 7710a	3995
Lobo hard drive for TRS80	3995
Lobo 400-t 5 1/4" for TRS80	388
Vista V-80 for TRS80 (40trk)	388
Corvus Systems hard drive	

APPLE COMPATIBLE PRODUCTS

Apple disk drive with controller	560
Apple drive without controller	495
Apple Parallel Interface	179
Ten Key Data Pad for Apple	119
Mountain Hardware Supertalk	279
Mountain / Intro X-10 for BSR	239
***** Memorex Special **********	
8" soft sector diskettes (10)	27
8" double density for TRS80	30

S-100 PRODUCTS

Godbout Rack Enclosure	$289
Godbout Desk Top Enclosure	329
Electronic Controls ECT 100F	250
Cal. Digital 18 slot motherbd.	30

S-100 BOARDS

Think/Toys Switchboard I/O	219
Godbout Econoram Products	
Mullin TB-2 Extend. & Logic	49
Artec WW100 WireWrap Proto	25
SD64K Expanderam Memory	

16 BIT S-100 BOARDS

Cal. Digital CAL-86	650
Tecmar 8086	650
Seattle Computers 8086	850
Godbout 8088/8085	
Ithaca Intersystems Z-8000	

MISCELLANEOUS

Cherry Pro ASCII Keybd.	129
Maxiswitch HEX Keyboard	49
UV Eraser 11-E	65
Super Mod II RF Modulator	30

Authorized Distributor Scotch® Data Products

		10 Pak	50+
740-0	IBM soft format.	$39.00	$3.50
740/2	Double side soft	65.00	6.00
741-0	Double density	53.00	4.90
743-0	Double/Double	70.00	6.60
740-32	8" Hard sector	39.00	3.50
744-(0)(10)(16)	5 1/4" mini	39.00	3.50
Library case for any above;		Add $3.00	
834 A	Data Cassette	5.50	
DC 100	Mini Cartridge	16.00	
DC 300	Data Cartridge	20.00	
920( )	Disk Cartridge	39.00	

Shugart Associates

SA800-R Floppy Disk Drive

The most cost effective way to store data processing information, when random recall is a prime factor. The SA800 is fully compatible with the IBM 3740 format. Write protect circuitry, low maintenance & Shugart quality.

$449.50

XEROX 800 WORD PROCESSING KEYBOARD ASCII ENCODED

This 77 key word processing keyboard was manufactured by Microswitch for use in the Xerox 800 word processing system.
The keyboard outputs a seven bit ASCII code along with an eighth bit that allows most keys to shift and double function as special characters. Extra large "Tab & Return" keys are designed into the layout of the keyboard to emulate the IBM Selectric. 17 illuminated keys serve for special word processing codes. The keyboard is equipped with two thumbwheel switches for defining line width.
Original Xerox acquisition over $400.00
California Digital USED price only $49.00
Excellent cond. Documentation included.

MEMORY

TRS-80 APPLE II $49
16k memory (8) 4116's

Installation is simple. Anyone who has ever changed a spark plug should be able to up-grade his microcomputer.
How can California Digital offer these memory up-grade sets at 25% below our competition? Simple, we buy in volume, wholesale to dealers and sell the balance directly to owners of personal micro-systems. These 16K dynamic memory circuits are factory prime and unconditionally guaranteed for one full year. NOW, before you change your mind, pick up the telephone and order your up-grade memory from California Digital. Add $3 for TRS80 jumpers.

STATIC	1-31	32-99	100-5C	-999	1K+
21L02 450nS.	1.19	.99	.95	.90	.85
21L02 250nS.	1.49	1.39	1.25	*	*
2114 1Kx4 450	5.95	5.50	5.25	4.75	4.50
2114 1Kx4 300	8.95	8.50	8.00	*	*
4044 4Kx1 450	5.95	5.50	5.25	*	*
4044 4Kx1 250	9.95	9.50	9.00	*	*
4045 1Kx4 450	8.95	8.50	8.00	*	*
4045 1Kx4 250	9.95	9.50	9.00	*	*
5257 low pow.	5.95	5.50	5.00	4.80	4.60

DATA INPUT TERMINAL

$49

This Keystation terminal was recently acquired from the CMC division of the Pertec Corporation. The unit was originally designed for inputing data directly onto magnetic tape.

The system is comprised of a premium cast aluminium and fiberglass enclosure, along with a Honeywell / Microswitch hall effect keyboard. Thirty display lamps advise the operator of the systems status. Four inch loud speaker acknowledges acceptance of data and alerts the operator of pending problems.
But most of all this "USED" terminal, with a little imagination, can be engineered to make the perfect home for an S-100 computer and video display; or with slight modification will accept the Rockwell AIM-65 micro/computer.
Five volt regulated power supply is available for an additional $20. (see June Byte)
All units are in excellent condition Original acquisition over $700. 22 lbs.

BMC VIDEO MONITOR $259

Green phosphor with 18 MHz bandwidth, composit video input make the BMC KG-12C an ideal monitor for anyone requiring a high resolution display with an 80 character by 25 line video format. 12" 90° deflection.
High impact plastic enclosure assures that the BMC monitor is a rugged take anywhere instrument.
For added protection the unit is equipped with a removable smoked non-glare fitted plexiglas screen. Shipping 18 lbs.

MINIATURE SWITCHES

your choice

	10	50
$.98	$.88	.81

SPDT Miniature Toggles

7101 C&K	ON-NONE-ON
7107 jbt	ON-OFF(mnt.ON)
7108 CK	ON-(moment ON)
7103 CK	ON OFF ON
Rotary	3P-4-Pos.
Rotary	3P-6-Pos.
Push B (N.O.)	$.39ea. 4/$1

DIP Switch

	10	25	100	1K
$1.29 ea.	$1.19	1.09	.97	.83

specify 4, 7 or 8 pos.
SPST

direct connect MODEM Universal Data 103



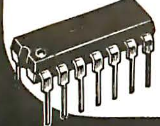
Connects directly to the new modular phone jack. Fully powered from your existing telephone line. No need to locate external AC power. Crystal control prevents frequency drift. Direct connect feature eliminates loss of information due to carbon compression that is associated with acoustic modems. Runs circles around those other "Domesticated" modems.

$169

KEYBOARD $24.95

This classic Hytek keyboard is similar to the module used in the Decwriter Terminal.
62 non-encoded contacts three locking.
Factory boxed Altair surplus. Shipping 3 lbs.

2716 EPROM SALE $13



*** THOUSANDS ***

We have slashed price in an effort to reduce our over stocked inventory. These are Single Five Volt Eproms, manufactured by one of the Worlds largest producers of semiconductors. Please phone for volume pricing.



$139.50

PORTABLE DATA ENTRY SYSTEM

These used data terminals were originally designed for chain store inventory control and order entry systems. The operator enters the inventory control number, merchandise on hand and the unit price. After all pertinent data has been entered into the recorder, the main warehouse is telephoned, the handset is placed in the acoustic coupler and all the recorded information is transmitted back to the master computer.
With a little imagination and one of these portable entry systems, you should be able to exchange programs and computer information with associates across the country.
All units were removed from service in working condition. Original cost $2,500.
Each system comes complete with:

- Portable Cassette Drive Unit
- Removable Entry Keyboard with LED Display
- Five Gould "D" NiCads
- Acoustical Coupler
- Battery Charger
- DB25 Cable
- Shoulder starp
- Full Documentation

BSR SYSTEM X-10

The new BSR timer runs your home like clockwork. Turns on lamps and appliances while your away from home. Completely compatible with your existing system X-10 devices.





BSR Timer	$65.00
Master Console	34.95
Ultrasonic Controller	19.95
Modules: Appliance, Lamp or Wall Switch	13.95



All merchandise sold by California Digital is premium grade.
Shipping: First five pounds $2.00; each additional add $.40
Foreign orders 10% shipping. Excess will be refunded.
California residents add 6% sales tax. COD's discouraged.
Open accounts extended to state supported educational institutions and companies with a "Strong Dun & Bradstreet."
Warehouse: 15608 Inglewood Blvd. Visitors by appointment.

TOLL FREE ORDER LINE (800) 421-5041
TECHNICAL & CALIFORNIA (213) 679-9001

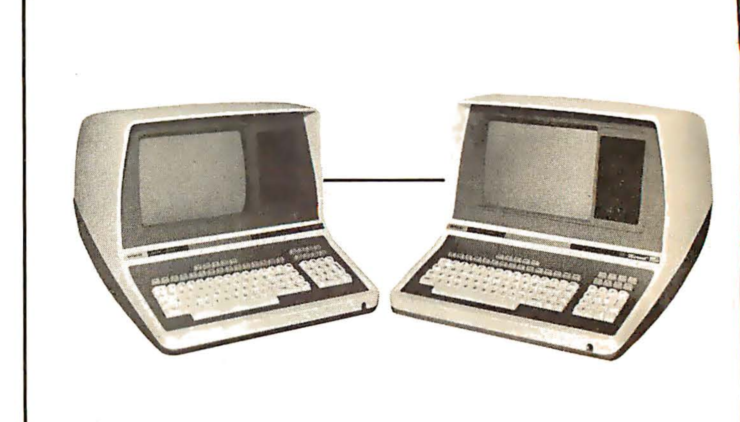
Circle 344 on inquiry card.

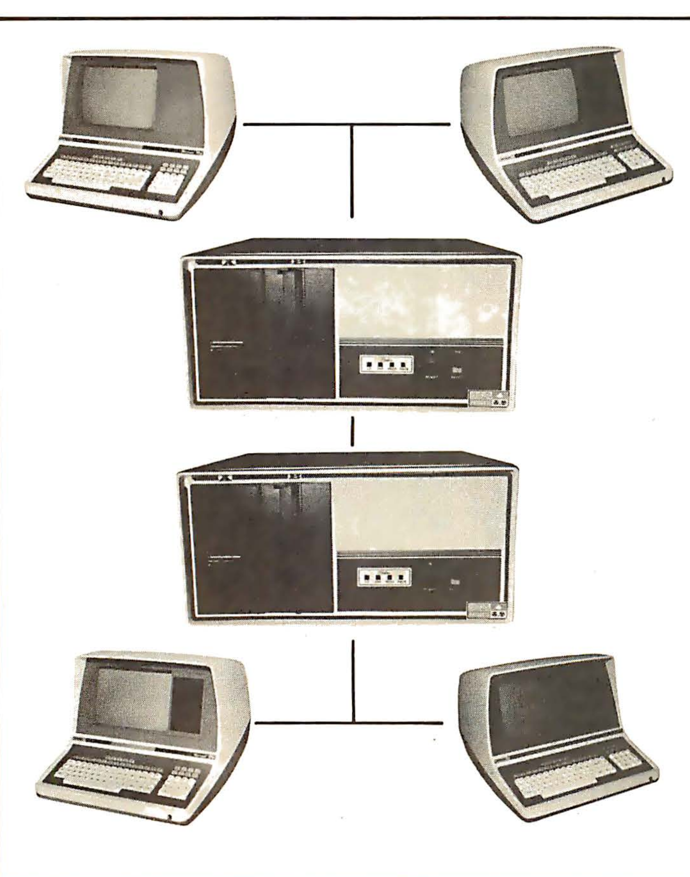
DP/NET: Redefined

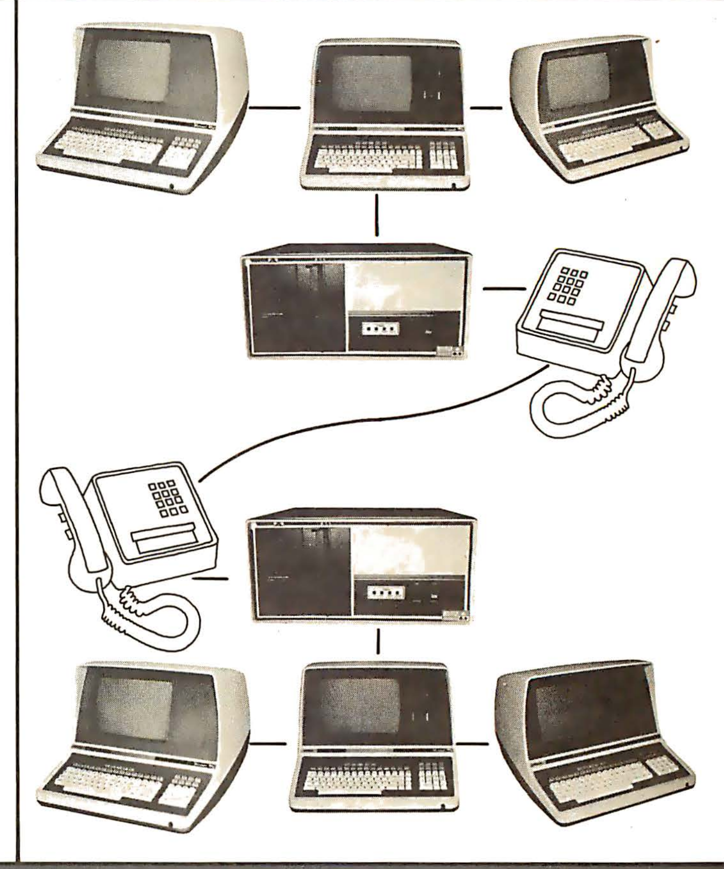
INDIVIDUAL/NET



DUAL/NET







LOCAL/NET

TELEPHONE/NET

OVERSEAS

AUSTRALIA
ASP MICROCOMPUTERS
799 Dandenong Road
East Malvern 3145
Victoria, AUSTRALIA
TEL: 2118855-2118344

UNITED KINGDOM
TERODEC (MICRO SYSTEMS) LTD.
17 The Gallop, Yateley,
Camberley, Surrey
GU17 7SG ENGLAND
TEL: 0252 874790

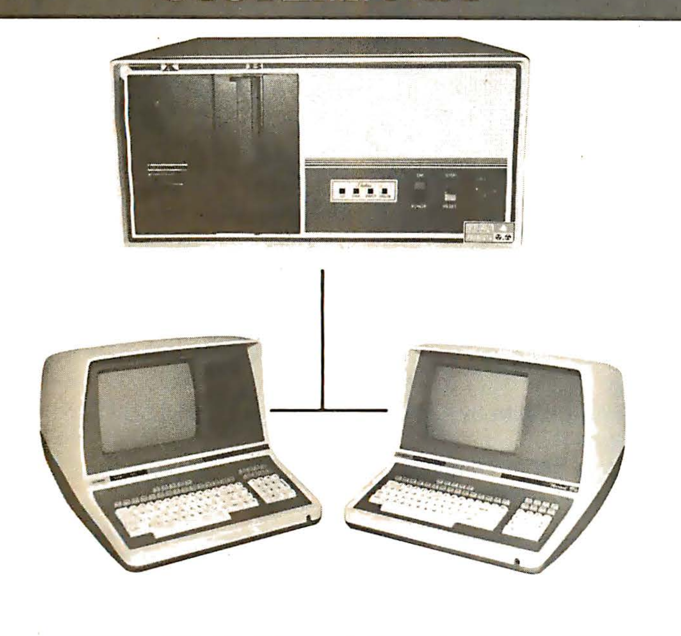
CENTRAL EUROPE
HANNES KELLER AG
Computer-Zentrum
Eidmattstrasse 36
CH-8032, Zurich
SWITZERLAND
TEL: 01 69 36 33

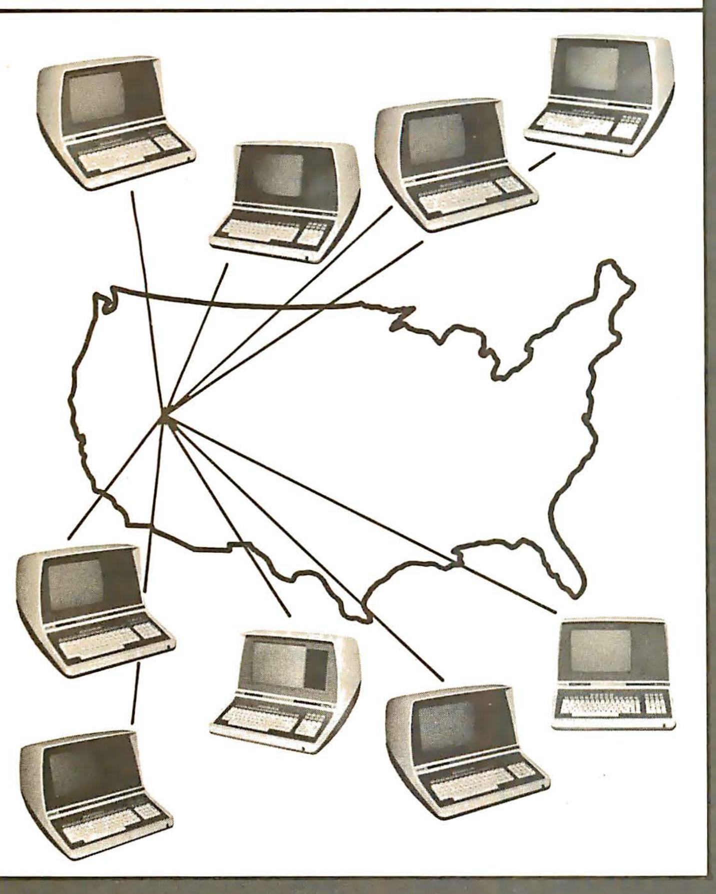
SOUTH AMERICA
INVERSIONES URIMAN c.a.
P.O. Box 1041
Maracaibo 4001A,
VENEZUELA
TEL: 33015

FAR EAST
MICROBOARDS
1-7-1-1003 Saiwai-Cho
Chiba City, Chiba 260 JAPAN
TEL: 0472(47)3081

Configurability

SYSTEM/NET





MASTER/NET

"BUY" WORD FOR THE 1980's

NET WORKING is the newest 'buzzword' in microprocessors. Delta Products has produced a superior hardware system that cannot be matched in either cost or performance.

Don't buy a system that has "designed-in" limitations; check the following:

PERFORMANCE

This is where DP/NET® beats them all. Delta does multiuser and multitasking operations by using distributed processors. DIGITAL RESEARCH has provided a new operating system (CP/NET®) which combines MP/M® and CP/M 2.2® into the world's most powerful microcomputer system.

The system cannot be bogged down by adding more users. High-speed DMA transfers from Host to Slave, allow many processors to share workloads. (There can be 3 processors at EACH user terminal; a Z-80 for screen function, and a pair of 8085/8088 for main processing.)

FLEXIBILITY

One of the most important advantages of DP/NET® is that you never have to purchase more system than you currently need. Your system can start with a 5" minifloppy 32K terminal for under $3000.00. Adding a second terminal and additional mass storage is as simple as the original purchase. Networking up to 16 OR MORE intelligent and semi-intelligent work stations can follow in perfect step with the growth of your Company and requirements.

COST

Since you never buy more computer power than you need, the system cost is matched to the demand to be placed upon it. DELTA PRODUCTS has a lot of experience in building micros, with over 2000 DELTA systems now in the field. DELTA component cost has always been extremely competitive. DELTA's new "networking system" is a natural and simple combination of the competitive "good deals" we have been offering for some time.

SOFTWARE

A computer system to the end user IS THE SOFTWARE. All CP/M® compatible programs run perfectly on the DP/NET®. DELTA PRODUCTS is currently writing its' own high-performance custom data base, screen editor, order entry/inventory, and accounting packages in PL/1®. Target release date for the complete package is November, 1980.

SOLD ONLY THROUGH DEALERSHIPS
CALL FOR YOUR NEAREST REPRESENTATIVE

DELTA PRODUCTS

15392 Assembly Lane
Huntington Beach, CA 92649
TELEPHONE: (714) 898-1492



TELEX: 681-367 DELTMAR HTBH

MP/M, CP/M2.2, PL/1 & CP/NET ARE REG. TM OF DIGITAL RESEARCH INC.

Circle 345 on inquiry card.



Look to QT for the BIG +

THE GREAT Q.T. BOARD SET SALE

USER PROVEN BOARD SETS AT NOT MUCH ABOVE OUR WHOLESALE COST.
6 SLOT MOTHER BOARD KIT **FREE** WITH EACH BOARD SET PURCHASED.

Q.T. BOARD SET #1 (KIT) — FOR STARTERS

Z+80 CPU (Rev I)
Expandable + with 32K
Monitor-BIOS For Serial Terminal

Normal Retail $525.00
Q.T. Price **$425.00**

S.D. BOARD SET #1 (KIT) — FOR SERIOUS HOBBYISTS

SBC-100
Expandoram I with 32K RAM
Versafloppy I
Monitor For Serial Terminal
BIOS for 8" or 5¼" Drives

Normal Retail $950.00
Q.T. Price **$850.00**

Q.T. BOARD SET #2 (KIT) — FOR HOBBYISTS

Z+ CPU (Rev I)
Expandable + with 64K
Versafloppy II
Monitor BIOS For Serial Terminal

Normal Retail $1050.00
Q.T. Price **$850.00**

S.D. BOARD SET #2 (KIT) — FOR SMALL BUSINESSES & SOFTWARE DEVELOPERS

SBC-200
Expandoram II with 32K RAM
Versafloppy II
Monitor For Serial Terminal
BIOS for Disk Drives

Normal Retail $1150.00
Q.T. Price **$1000.00**

PARTICIPATING IN THIS SALE ALSO ENTITLES YOU TO SUCH BONUSES AS:

1. $44.00 Per set of 4116's — 200ns devices only
2. Free second page of memory option in all Televideo 912 & 920 Smart CRT's.

QT MEMORY EXPANSION KITS FOR

TRS-80 • APPLE • EXIDY

4116 200 ns
8 for **$49.50**

2716 (5V - 450 ns)
$18.00

2716 (5 & 12V-450 ns)
$14.00

TELEVIDEO SMART (CRT) TERMINAL

• Reverse Video • Blinking/blank fields • Upper/lower case character • Protected fields • Non-glare screen • Underlining • 12 x 10 character resolution • Single stroke editing keys • Function keys • Blinking cursor • TTY keyboard • Numeric pad • 9 Baud rates (75-9600 Baud) • Self-test • Printer port

912B	$750.00
920B	$850.00
920C	$900.00
OPTION:	
2nd Page Memory	$ 24.95
Freight Charge	$ 15.00

Nationwide Field Service available from General Electric Instrumentation and Communication Equipment Service Shops.

SWITCHABLE 2 or 4 MHz
THE QT Z+80 REV 1

Z-80A CPU with Serial I/O Port

The CPU can accommodate a 2708, 2716, or 2732 EPROM in SHADOW Mode, allowing you to use a full 64K of RAM. The MWRITE signal is generated automatically if you use the board without a front panel. There's also an independent on-board USART to control the RS232 serial port at baud rates from 110 to 9600.

CPU-Z+80K (KIT)	$132.00
CPU-Z+80AT (A&T)	$189.00
CPU-Z+80BB (BARE BOARD)	$ 33.00

VERBATIM & MEMOREX

Part No.	Sectoring	Pkg. of 2	Box of 10
QTMO 525 01	Soft Sector	$ 8.95	$29.95
QTMO 525 10	Hard 10 Sector	$ 8.95	$29.95
QTMO 525 16	Hard 16 Sector	$ 8.95	$29.95
QTFO32 1000	Hard Sector	$11.95	$34.95
QTFO34 1000	Soft Sector	$11.95	$34.95

KASETTE/10 LIBRARY

Part No.		
CAS-10-8	Blue Grey / Beige Black	8" Diskette Holder $4.50 ...or 3/$10.00
CAS-10-5	Blue Grey / Beige Black	5" Diskette Holder $4.25 ...or 3/$10.00

SPECIAL PACKAGE PRICE

1 Male DB-25, 1 Female DB-25, 1 Cover
RS-232 SET $6.50

PARTS

MICROPROCESSORS	
Z80 (2 MHz)	$10.95
Z80A (4 MHz)	$12.95
6502	$11.25
6800	$12.50
6802	$19.50
8035	$20.00
8080A	$ 3.95
8085A	$20.00
8086-4	$60.00
8748-8	$70.00

8080A SUPPORT	
8212	$ 3.50
8214	$ 4.50
8216	$ 2.95
8224	$ 4.00
8228	$ 6.00
8238	$ 6.00
8243	$ 5.00
8251	$ 7.00
8253	$19.00
8253-5	$27.00
8255	$ 6.25
8257	$17.95
8257-5	$19.00
8259	$19.95
8275	$69.95
8279	$17.50
8279-5	$18.00
8295	$16.50

KEYBOARD CHIPS	
AY5-2376	$13.75
AY5-3800	$13.75

BAUD RATE GENERATORS	
MC14411	$11.00
1.8432 XTAL	$ 4.95
BR1941L	$10.00

DISC CONTROLLER	
1771B01	$24.95
1791B01	$39.95

EPROMS	
1702A	$ 4.95
2708	$ 6.75
2516	$22.00
2758	$27.00
2532	$75.00
2732	$75.00

USRT	
S2350	$10.95

MISCELLANEOUS OTHER COMPONENTS	
N8T20	$ 3.25
N8T28	$ 2.50
N8T97	$ 2.00
N8T98	$ 2.00
1488	$ 1.25
1489	$ 1.25
D3205	$ 3.00
D3242	$10.15
D3245	$ 5.60
P3404	$ 8.75
TMS5501	$19.00
DM8131	$ 3.00

CRT CONTROLLER	
MC6845P	$18.00

STATIC RAMS	
2114L (450 ns)	$5.25 ea. ... 100 ea./$4.50 ea.
2114L (300 ns)	$5.50 ea. ... 100 ea./$4.75 ea.

UARTS	
TR1602B	$ 3.75

CHARACTER GENERATORS	
2513 (Upper case)	$10.95
2513 (Lower case)	$10.95
2513 Upper (5 v)	$ 9.75
2513 Lower (5 v)	$10.95

PLACE ORDERS TOLL FREE 1-800-421-5150
Retail store open 10:00 A.M. to 6:00 P.M.
Daily except Sunday.

(Continental U.S. Only)
(Except California)

Circle 346 on inquiry card.

SSM PRODUCTS

CB2 Z-80 CPU

Kit	$195.00
Assembled & Tested	$275.00

•2MHz, 4MHz, Mixed • Type—2716 or 2732 (not incl.) • Dip switch addressing • One wait state added • Dip switch disable • Type—TMS 4016 (not incl.) • 8 additional address lines • Power on/reset firmware jump using first instruction in EPROM

IO4 2P + 2S I/O Interface

Kit	$134.95
Assembled & Tested	$199.95

• Two serial ports with status • Two parallel inputs • Two parallel outputs • Current-loop by optical isolators • UART presets by dip switch: —stop bits —word length —parity even and odd • Dip switch addressing of serial I/O to any four port boundary • Dip switch addressing of parallel I/O to any two port boundary

S-100 BARE BOARDS

CB1A 8080 CPU	$33.00
VB2 I/O Mapped Video Interface	$33.00
102 Parallel I/O Interface	$33.00
104 2P + 2S I/O Interface	$33.00
SB1 Music Synthesizer	$40.00
OB1 Vector Jump & Prototyping Board	$29.95
MB3 4K 1702 EPROM Board	$30.00
MB6B 8K Static RAM	$27.00
MB7 Low Power 16K Static RAM	$30.00
MB8A 16K 2708 EPROM Board	$30.00
T1 Terminator	$26.00
MTI 15 Slot Motherboard	$40.00
XB1 Extender Board	$13.50

S-100 KITS & ASSEMBLED BOARDS

CB1A 8080 CPU

Kit	$149.95
Assembled & Tested	$199.95

PB1 2708/2716 EPROM Programmer

Kit with Textool sockets	$134.95
Assembled & Tested w/Textools sockets	$174.95

• 2708 EPROM (not included) • 2716 EPROM +5V type (not included) • Any 4K boundary • Separate 2708 and 2716 sockets • Any 4K/8K boundary above 8000 Hex • Optional Textool sockets (for programming only) • Programming software & bit for bit verify routines provided

IO2 Parallel I/O Interface

Kit	$ 59.00
Assembled & Tested	$ 89.00

MB3 4K 1702 EPROM Board

Kit - without EPROMS	$ 65.00
Assembled & Tested	$125.00

MB6B 8K Static RAM
450 ns RAM

Kit	$139.95
Assembled & Tested	$199.95

250 ns RAM (MB6B)

Kit	$179.95
Assembled & Tested	$245.00

MB7 Low Power 16K Static RAM

Kit	$325.00
Assembled & Tested	$375.00

MB8A 16K 2708 EPROM Board

Kit - without EPROMS	$ 99.00
Assembled & Tested	$159.00

QT TECHNICAL HOTLINE
(213) 973-2619

VB3 80 Character Video Interface

80x24 Display, 2 MHz

Kit	$324.95
Assembled & Tested	$399.95

80x24 Display, 4 MHz

Kit	$369.95
Assembled & Tested	$439.00

• 80 char. per line, up to 51 lines • Graphics up to 160 x 204 matrix • Upper & lower case characters • Software controlled timing, top & bottom margins, horiz. position • U.S. & European T.V. timing • 4096 Bytes (8192 bytes optional) • Switch addressing, 8K increments • CP/M compatible driver routine

MT1 15 Slot Motherboard

Kit (with Connectors)	$119.95
Assembled & Tested	$149.95

OB1 Vector Jump & Prototyping Board

Kit	$ 55.00
Assembled & Tested	$ 85.00

SB1 Music Synthesizer (4)

Kit	$199.00
Assembled & Tested	$279.00

T1 Active Terminator

Kit	$ 34.00
Assembled & Tested	$ 64.00

VB1B Memory Mapped Video Interface
LIMITED SUPPLY — DISCONTINUED BOARD

Kit	$149.95
Assembled & Tested	$180.00

VB2 I/O Mapped Video Interface

Kit	$160.00
Assembled & Tested	$210.00

XB1 Extender Board

Kit (with Connector)	$ 19.95
Assembled & Tested	$ 29.95

EXPANDORAM I

EXPANDABLE TO 64K USING 4116 RAMS

• For S-100 boards • Bank selectable, PHANTOM provision • Designed to work with Z-80, 8080, and 8085 systems • No wait states required • 16K boundaries & protect via dip switches • Invisible refresh

MEM-16K (16K KIT)	$199.00
MEM-16AT (16K A&T)	$249.00
MEM-32K (32K KIT)	$250.00
MEM-32AT (32K A&T)	$300.00
MEM-48K (48K KIT)	$309.00
MEM-48AT (48K A&T)	$359.00
MEM-64K (64K KIT)	$364.00
MEM-64AT (64K A&T)	$410.00

EXPANDORAM II

• For S-100 Bus • 4Mhz Operation • Expandable Memory from 16K to 256K • Dip Switch Selectable Boundaries • Uses 16K (4116) or 64K (4164) Memory Devices • Page Mode Operation Allows up to 8 Memory Boards on Bus • For Z80 CPU's • Phantom Output Disable • Invisible Refresh

MEMII-16K (KIT)	$250.00
MEMII-16AT (A&T)	$300.00
MEMII-32K (KIT)	$309.00
MEMII-32AT (A&T)	$360.00
MEMII-48K (KIT)	$369.00
MEMII-48AT (A&T)	$409.00
MEMII-64K (KIT)	$425.00
MEMII-64AT (A&T)	$475.00

QT LOW PRICES!

5¼″ DISK DRIVES

MPI B-51	$295.00
SHUGART SA400	$295.00

8″ DISK DRIVES

SHUGART 8″ 801R	$475.00
REMEX RFD 4000	$635.00

SD SYSTEMS

VERSAFLOPPY II

DOUBLE DENSITY DISK CONTROLLER

• For single or double density • 985600 bytes on 8″ double sided diskettes • 259840 bytes on double sided 5¼″ diskettes • S-100 bus • IBM 3740 format in single density • 8″ and 5¼″ drives controlled simultaneously • Operates with Z-80, 8080, and 8085 CPU's • Controls up to 4 drives

VF-2K (KIT)	$300.00
VF-2AT (A&T)	$369.00

SBC-100/200

2 OR 4 MHz SINGLE BOARD COMPUTER

• S-100 bus Z-80 CPU BD • 1K of on-board RAM • 4 EPROM sockets accommodates 2708, 2716, or 2732 • One parallel and one serial I/O port • 4-channel counter timer chip (Z-80 CTC) • Software programmable serial baud rates

SBC-100K (2 MHz KIT)	$255.00
SBC-100AT (2 MHz A&T)	$325.00
SBC-200K (4 MHz KIT)	$289.00
SBC-200AT (4 MHz A&T)	$369.00

SSM APPLE SERIAL/PARALLEL INTERFACE

AI/O Kit	$125.00
AI/O A&T	$165.00

TEXTOOL
ZIP* DIP II SOCKETS

16 PIN ZIP* DIP II	$ 5.50
24 PIN ZIP* DIP II	$ 7.50
40 PIN ZIP* DIP II	$10.25

*ZERO INSERTION PRESSURE

PROM-100

• For S-100 Bus • Programs the Following EPROMs: 2708, Intel 2758, 2716, 2732 and TI 2516 • Dip Switch Selection of EPROM type • 25 VDC Programming Pulse Generated On Board • Maximum Programming Time: 16,384 Bits in 100 seconds • Software Provides for Reading of Object File from SDOS, CP/M or PROM and Programming into EPROM • Program Verification • Verification of Erasure • Zero Insertion Force Socket

PROM-100K (KIT)	$175.00
PROM-100AT (A&T)	$225.00

Z-80 STARTER KIT

COMPLETE Z-80 MICROCOMPUTER

• On-board keyboard, display, EPROM Programmer, and cassette interface • On-board S-100 interface interface • Wire-wrap area and room for 2 S-100 connectors • Two 8-bit parallel I/O ports, 4-channel CTC, 5 programmable breakpoints • Examine and change memory, I/O ports, or register

Z-80K (KIT)	$289.00
Z-80AT (A&T)	$349.00

$25 REBATE

on any SD Systems microcomputer board

Offer expires 10-31-80

STATIC RAM BOARDS

SR-8K BARE BD (Ithaca Audio) 21L02	$ 19.00
SR-16K BARE BD (Problem Solvers) 2114	$ 19.00
SR-16K A&T (Cal. Comp Sys) 2114L 4MHz	$269.95
SR-32K KIT (Uses 2114L) **4MHz**	$475.00
SR-32K A&T (Uses 2114L) **4MHz**	$500.00



PLACE ORDERS TOLL FREE
1-800-421-5150
(CONTINENTAL U.S. ONLY)
(EXCEPT CALIFORNIA)

TERMS OF SALE: Cash, checks, money orders, credit cards accepted. Also C.O.D. orders under $100.00. Minimum order $10.00. California residents add 6% sales tax. Minimum shipping and handling charge $2.50.
Prices subject to change without notice.
International sales in American dollars only



Circle 346 on inquiry card.

$2130.00 COMPUTER GET A JADE INFLATION

JADE Saves You $1130

4 MHz BOARD SET
SD Systems A & T Price

SBC-200 *CPU with I/O* $400.00
Versafloppy II *Dbl density controllr* . $430.00
ExpandoRAM II *64K RAM 4 MHz* . $1300.00
Total price $2130.00
JADE KIT PRICE $1074.95
Less SD Systems Rebate $75.00
YOUR COST ONLY $999.95

S-100 Boards

THE BIG Z - Jade
2 or 4 MHz switchable Z-80 CPU with serial I/O

CPU-30201K *Kit* $145.00
CPU-30201A *A & T* $199.00
CPU-30200B *Bare board* $35.00

SBC-100 - SD Systems
2.5 MHz Z-80 CPU with serial & parallel I/O ports

CPC-30100K *Kit* $257.50
CPC-30100A *A & T* $325.00

SBC-200 - SD Systems
4 MHz Z-80 CPU with serial & parallel I/O ports

CPC-30200K *Kit* $299.95
CPC-30200A *A & T* $375.00

CB2 - S.S.M.
2 or 4 MHz switchable Z-80 CPU with RAM, ROM, & I/O

CPU-30300K *Kit* $185.00
CPC-30300A *A & T* $249.95

ExpandoRAM I - SD Systems
2.5 MHz RAM board expandable from 16K to 64K

MEM-16130K *16K kit* $189.00
MEM-16130A *16K A & T* $249.00
MEM-32131K *32K kit* $234.00
MEM-32131A *32K A & T* $294.00
MEM-48132K *48K kit* $279.00
MEM-48132A *48K A & T* $339.00
MEM-64133K *64K kit* $324.00
MEM-64133A *64K A & T* $384.00

ExpandoRAM II - SD Systems
4 MHz RAM board expandable from 16K to 256K

MEM-16630A *16K kit* $249.95
MEM-16630A *16K A & T* $299.95
MEM-32631K *32K kit* $309.95
MEM-32631A *32K A & T* $359.95
MEM-48632K *48K kit* $369.95
MEM-48631A *48K A & T* $409.95
MEM-64633K *64K kit* $429.95
MEM-64633A *64K A & T* $479.95

32K STATIC RAM - Jade
2 or 4 MHz expandable static RAM board uses 2114L's

MEM-16150K *16K 2 MHz kit* $249.95
MEM-16150A *16K 2 MHz A & T* ... $299.95
MEM-16151K *16K 4 MHz kit* $259.95
MEM-16151A *16K 4 MHz A & T* ... $309.95
MEM-32150K *32K 2 MHz kit* $399.95
MEM-32150A *32K 2 MHz A & T* ... $449.95
MEM-32151K *32K 4 MHz kit* $409.95
MEM-32151A *32K 4 MHz A & T* ... $459.95

16K STATIC RAM - Cal Comp Sys
2 or 4 MHz 16K static RAM - a real memory bargain

MEM-16160K *16K 2 MHz kit* $249.95
MEM-16160A *16K 2 MHz A & T* ... $279.00
MEM-16162K *16K 4 MHz kit* $279.95
MEM-16162A *16K 4 MHz A & T* ... $309.00
MEM-16160B *Bare board* $29.95

Call for your free 1980 catalog

DOUBLE-D - Jade
Double density controller with the inside track

IOD-1200K *Kit* $299.95
IOD-1200A *8" A & T* $389.95
IOD-1205A *5¼" A & T* $389.95
IOD-1200B *Bare board* $65.00

VERSAFLOPPY I - SD Systems
Versatile floppy disk controller for 8" or 5¼"

IOD-1150K *Kit* $219.95
IOD-1150A *A & T* $269.95

VERSAFLOPPY II - SD Systems
New double density controller for both 8" & 5¼"

IOD-1160K *Kit* $309.95
IOD-1160A *A & T* $369.95

I/O-4 - S.S.M.
2 serial I/O ports plus 2 parallel I/O ports

IOI-1010K *Kit* $129.95
IOI-1010A *A & T* $189.95
IOI-1010B *Bare board* $29.95

PB-1 - S.S.M.
2708, 2716 EPROM board with built-in programmer

MEM-99510K *Kit* $119.95
MEM-99510A *A & T* $169.95

PROM-100 - SD Systems
2708, 2716, 2732, 2758, & 2516 EPROM programmer

MEM-99520K *Kit* $175.00
MEM-99520A *A & T* $225.00

32K BYTESAVER - Cromemco
32K EPROM board with on-board 2716 programmer

MEM-32550A *A & T* $295.00

100K DAY CLOCK - Mtn Hardware
Crystal controlled S-100 clock with NiCad backup

IOK-1400A *A & T* $329.95

SB1 - S.S.M.
15 Hz to 25K Hz music synthesizer for S-100

IOS-1005K *Kit* $189.95
IOS-1005A *A & T* $269.95

TB-4 - Mullen
Extremely versatile extender board with logic probe

TSX-180K *Kit* $55.00
TSX-180A *A & T* $75.00

TERMINATOR & EXTENDER - C.C.S.
Can be used as both an S-100 extender and terminator

TSX-150K *Kit* $39.95

S-100 EXTENDER - Cal Comp Sys
Puts problem boards within easy reach

TSX-160A *A & T* $24.95

VDB-8024 - SD Systems
80 x 24 I/O mapped video board with keyboard I/O

IOV-1020K *Kit* $324.95
IOV-1020A *A & T* $379.95

VB3 - S.S.M.
80 x 24 or 80 x 48 memory mapped with graphics

IOV-1095K *Kit, 4 MHz* $339.95
IOV-1095A *A & T, 4 MHz* $399.00
IOV-1096K *80 x 48 upgrade, 4 MHz* . $89.00

VIDEO BOARD - Jade
64 x 16 assembled & tested S-100 video board

IOV-1050B *Bare board* $29.95
IOV-1050A *A & T sale price* $99.95

8K RAM BOARDS - Special Sale
Uses 21L02 RAM chips

2 boards & manual for $30.00

Call for your free 1980 catalog

Single Board Computer

AIM-65 - Rockwell
6502 computer with printer, display, & keyboard

CPK-50165 *1K AIM* $374.95
CPK-50465 *4K AIM* $449.95
SFK-74600008E *8K BASIC ROM* ... $99.95
SFK-64600004E *4K assembler ROM* $84.95
PSX-030A *Power supply* $59.95
ENX-000002 *Enclosure* $49.95
4K AIM, 8K BASIC, power supply, & enclosure
Special package price $599.00

32K RAM - for AIM-65
Dynamic memory board to expand your AIM-65

MEM-99170A *A & T w/out RAM* .. $275.00
MEM-16170A *A & T w/16K* $325.00
MEM-32170A *A & T w/32K* $375.00
MEM-99170B *Bare board* $49.00

DISK CONTROLLER - for AIM-65
Add 5¼" or 8" disk drives to your AIM-65

IOD-3013A *A & T* $575.00

VISIBLE MEMORY - for AIM-65
Video board with 8K memory & graphics for AIM-65

IOV-3011A *A & T* $239.95

MEMORY-MATE - for AIM-65
The master-mater with 48K RAM, I/O, PROM, & music

MEM-52301A *A & T w/16K* $475.00

Z-80 STARTER KIT - SD Systems
Z-80 computer with RAM, ROM, I/O, & keyboard

CPS-30010K *Kit* $289.95
CPS-30010A *A & T* $349.95

Accessories for Apple

16K MEMORY UPGRADE
Add 16K of RAM to your TRS-80, Apple, or Exidy

MEX-16100K *TRS-80 kit* $47.95
MEX-16101K *Apple kit* $47.95
MEX-16102K *Exidy kit* $47.95

DISK DRIVE for APPLE
5¼" disk drive with controller for your Apple

MSM-12310C *with controller* $495.00
MSM-123101 *w/out controller* $425.00

8" DRIVES for APPLE
Controller, DOS, two 8" drives, cabinet, & cable

Special package price $1475.00

AIO - S.S.M.
Parallel & serial interface for your Apple

IOI-2050K *Kit* $115.00
IOI-2050A *A & T* $155.00

SUP'R'TERMINAL - M & R Assoc
80 x 24 video display board for your Apple

IOV-2100A *A & T* $359.00

SUPERTALKER - Mtn Hardware
Speech recognition/synthesizer w/speaker & mike

IOS-2015A *A & T* $275.00

Z-80 CARD for APPLE
Z-80 CPU card with CP/M for your Apple

CPX-30800A *A & T* $345.00

MICROMODEM - D.C. Hayes
Auto answer/dial modem card for Apple or S-100

IOM-2010A *Apple modem* $349.95
IOM-1100A *S-100 modem* $375.00

SUP'R'MOD II - M & R Assoc
Color or B & W TV interface recommended for Apple

IOR-5050A *A & T* $29.95

NOW ONLY $999.95 (JUST ADD SOLDER) FIGHTING KIT TODAY

Printers

BASE 2 - Impact Printer
132 cps, bi-directional, tractor feed, & graphics
PRM-13100 .... $625.00

DP-9500 - Anadex
9 x 9 dot matrix, 176 column, 200 cps, & graphics
PRM-10500 *Standard DP-9500* $1495.00
PRM-10510 *with graphics & 2K* .. $1595.00

LP-80 - Matchless
9 x 7 matrix, 132 column, 125 cps, bi-directional
PRM-37204 .... $775.00

PAPER TIGER - Integral Data
132 column, parallel & serial, 150 cps, graphics
PRM-33440 *IDS-440* $950.00
PRM-33441 *IDS-440 w/graphics* .. $1050.00

MIPLOT - Watanabe Instruments
Intelligent graphics plotter uses 7 bit ASCII code
PRP-10800 .... $1075.00

SPINWRITER - NEC
65 cps, bi-directional, letter quality with tractor
PRD-55510 *with 2K buffer* $2995.00

Motherboards

ISO-BUS - Jade
Silent, simple, and on sale - a better motherboard

6 Slot (5¼" x 8⅝")
MBS-061B *Bare board* $19.95
MBS-061K *Kit* $39.95
MBS-061A *A & T* $49.95

12 Slot (9.3" x 8⅝")
MBS-121B *Bare board* $29.95
MBS-121K *Kit* $69.95
MBS-121A *A & T* $89.95

18 Slot (14½" x 8⅝")
MBS-181B *Bare board* $49.95
MBS-181K *Kit* $99.95
MBS-181A *A & T* $139.95

Mainframes

MAINFRAME - Cal Comp Sys
12 slot S-100 mainframe with 20 amp power supply
ENC-112105 *Kit* $309.95
ENC-112106 *A & T* $349.95

DISK MAINFRAME - NNC
Dual 8" drive cutouts with 8 slot motherboard
ENS-112320 *with 30 amp p.s.* $699.95

Video Monitors

VIDEO 100 - Leedex
12" B & W video monitor with 12 MHz bandwidth
VDM-801210 .... $139.95

VIDEO 100-80 - Leedex
81 x 24 version of Video 100 with metal cabinet
VDM-801230 .... $179.95

B & W MONITOR - Sanyo
High quality, high resolution video monitors
VDM-700901 *9" monitor* $209.95
VDM-701501 *15" monitor* $279.95

13" COLOR MONITOR - Zenith
The hi res color you've been promising yourself
VDC-201301 .... $449.00

Call for your free 1980 catalog

Disk Drives

JADE DISK PACKAGE
Double-D controller kit, two 8" double density disk drives, cabinet, power supply, & cables
Special package price $1295.00

DUAL 8" DRIVES - Lobo
A pair of double density Shugarts in a cabinet
MSF-12800R *2 single sided* $995.00
MSF-125202 *2 double sided* $1425.00

DISKETTES - Jade
Bargain prices on magnificent magnetic media

5¼" single sided, single density, box of 10
MMD-5110103 *Soft sector* $27.95
MMD-5111003 *10 sector* $27.95
MMD-5111603 *16 sector* $27.95

5¼" double sided, double density, box of 10
MMD-5220103 *Soft sector* $39.95

8" single sided, single density, box of 10
MMD-8110103 *Soft sector* $33.95

8" single sided, double density, box of 10
MMD-8120103 *Soft sector* $55.95

8" double sided, double density, box of 10
MMD-8220103 *Soft sector* $57.95

FLOPPY SAVERS - Tri-Star
Protect your valuable software from spindle damage
MMA-205 *5¼" kit* $13.95
MMA-208 *8" kit* $15.95

Software

CP/M 2.2 - Digital Research
Latest & most powerful release of CP/M
SFC-52506000D *Manual set* $24.95
SFC-52506000M *5¼" disk & manual* $149.95
SFC-52506000F *8" disk & manual* $149.95

MP/M - Digital Research
Multi-user operating system for Z-80 computers
SFC-52507000F *8" disk & manual* $295.00

PASCAL/MT - MetaTech
A powerful language for CP/M systems
SFC-73301001F *8" disk & manual* .$229.95

SDOS - SD Systems
DOS, CBASIC-2, Z-80 assembler/editor/linker
SFX-55001000D *Manual set* $24.95
SFX-55001002M *5¼" disks & man* $149.95
SFX-55001006F *8" disk & manual* $149.95

WORDSTAR - MicroPro Intl
The finest word-processing package for CP/M
SFC-13600100F *8" disk & manual* $395.00

VISICALC - Personal Software
Visible business/accounting calculator for Apple
SFA-24101005M *5¼" disk & manual* $145.00

SINGLE DRIVE COPY - for Apple
Make back-up disks with just a single Disk II
SFA-51150010M *5¼" disk & manual* $19.95

SUPER-TEXT - Muse
Professional word-processing package for Apple
SFA-13800085M *5¼" disk & manual* $99.95

Modems

NOVATION CAT
300 baud, auto answer/originate acoustic modem
IOM-5200A *Special sale price* $149.00

EPROM ERASER - L.S.Engineering
UV eraser for up to 48 EPROMs
XME-3200 *A & T* $39.95



MICROPROCESSORS
Z-80 .... $10.95
Z-80A $14.95
6502 .... $11.50
6800 .... $11.95
6802 .... $17.95
6809 .... $39.95
8035 .... $24.00
8035-8 ...... $24.00
8080A ...... $ 6.95
8085 .... $15.95
TMS9900JL .. $39.95

PROMS
2708 (450ns) $ 8.95
2716 (450ns) $29.95
2716 (5v) ... $29.95
2732 (5v) ... $69.95
2758 (5v) ... $29.95

RAMS
21L02 (2 MHz) ... $ 1.25
21L02 (4 MHz) ... $ 1.50
2114L (2 MHz) ... $ 5.75
2114L (4 MHz) ... $ 5.95
4116 .... $ 8.95
2147 (70ns) .... $ 39.95
4164 (64K x 1) $175.00
5257 (2 MHz) ..... $ 6.75
5257 (4 MHz) ..... $ 7.25

SUPPORT DEVICES
8212 .... $ 4.95
8214 .... $ 4.65
8216 .... $ 2.95
8224 .... $ 4.95
8224-4 .. $ 9.95
8226 .... $ 3.85
8228 .... $ 4.95
8238 .... $ 4.95
8243 .... $ 8.00
8250 .... $14.95
8251 .... $ 6.50
8253 .... $1 .95
8255 .... $ 6.50
8257 .... $19.95
8259 .... $17.95
8275 .... $49.95
8279 .... $15.95

UARTS
AY5-1013A .. $5.25
AY3-1014A .. $8.25
TR1602B ... $5.25
TMS6011 ... $5.95
IM6403 ..... $9.00

BAUD RATE GENERATORS
MC14411 .. $12.95
CRYSTAL .. $ 4.95

Z80 SUPPORT
3881 (PIO) ...... $ 9.50
3881-4 (PIO-4 MHz) .. $14.50
3882 (CTC) ...... $ 9.50
3882-4 (CTC-4MHz) .. $14.95
3883 (SIO) $29.50
3884 (SIO) $49.50

6800 SUPPORT
6821P . $ 5.95
6828P . $11.95
6834P . $12.95
6840P . $18.75
6850P . $ 4.80
6852P . $ 5.79
6875L . $ 7.40
68488P $25.00

PLACE ORDERS TOLL FREE

Inside California 800-262-1710
Continental U.S. 800-421-5500

For customer service or technical inquiries call 213-973-7707

Write for our FREE 1980 catalog

JADE COMPUTER PRODUCTS
4901 W.Rosecrans, Hawthorne, CA 90250

TERMS OF SALE: Cash, checks, credit cards money orders or from recognized institutions Purchase orders accepted. Minimum order $10.00 California residents add 6% sales tax. Minimum shipping and handling charge $2.50. Prices are for U.S. and Canadian delivery only and are subject to change without notice. For export prices and information send for a JADE INTERNATIONAL CATALOG.







Circle 347 on inquiry card.

7400 TTL

SN7400N	.20	SN7470N	.29	SN74160N	.89
SN7401N	.20	SN7472N	.29	SN74161N	.89
SN7402N	.20	SN7473N	.35	SN74162N	1.95
SN7403N	.20	SN7474N	.35	SN74163N	.89
SN7404N	.25	SN7475N	.49	SN74164N	.89
SN7405N	.25	SN7476N	.35	SN74165N	.89
SN7406N	.29	SN7479N	5.00	SN74166N	1.25
SN7407N	.29	SN7480N	.50	SN74167N	1.95
SN7408N	.20	SN7482N	.99	SN74170N	1.59
SN7409N	.20	SN7483N	.69	SN74172N	6.00
SN7410N	.18	SN7485N	.89	SN74173N	1.25
SN7411N	.25	SN7486N	.35	SN74174N	1.00
SN7412N	.25	SN7489N	1.75	SN74175N	1.00
SN7413N	.40	SN7490N	.45	SN74176N	.79
SN7414N	.70	SN7491N	.59	SN74177N	.79
SN7416N	.25	SN7492N	.43	SN74179N	1.95
SN7417N	.25	SN7493N	.43	SN74180N	.79
SN7420N	.20	SN7494N	.65	SN74181N	1.95
SN7421N	.29	SN7495N	.65	SN74182N	.79
SN7422N	.39	SN7496N	.65	SN74184N	1.95
SN7423N	.25	SN7497N	3.00	SN74185N	1.95
SN7425N	.29	SN74100N	1.25	SN74186N	9.95
SN7426N	.29	SN74107N	.35	SN74188N	3.95
SN7427N	.25	SN74109N	.59	SN74190N	1.25
SN7429N	.39	SN74116N	1.95	SN74191N	1.25
SN7430N	.20	SN74121N	.35	SN74192N	.79
SN7432N	.25	SN74122N	.39	SN74193N	.79
SN7437N	.25	SN74123N	.59	SN74194N	.89
SN7438N	.40	SN74125N	.49	SN74195N	.69
SN7439N	.25	SN74126N	.49	SN74196N	.89
SN7440N	.20	SN74132N	.75	SN74197N	.89
SN7441N	.89	SN74136N	.75	SN74198N	1.49
SN7442N	.59	SN74141N	.79	SN74199N	1.49
SN7443N	.75	SN74142N	2.95	SN74S200	4.95
SN7444N	.75	SN74143N	2.95	SN74251N	.99
SN7445N	.75	SN74144N	2.95	SN74279N	.79
SN7446N	.69	SN74145N	.79	SN74283N	2.25
SN7447N	.59	SN74147N	1.95	SN74284N	3.95
SN7448N	.79	SN74148N	1.29	SN74285N	3.95
SN7450N	.20	SN74150N	1.25	SN74365N	.69
SN7451N	.20	SN74151N	.59	SN74366N	.69
SN7453N	.20	SN74152N	.59	SN74367N	.69
SN7454N	.20	SN74153N	.59	SN74368N	.69
SN7459A	.25	SN74154N	1.50	SN74390N	1.95
SN7460N	.20	SN74155N	.79	SN74393N	1.95
		SN74156N	.79		
		SN74157N	.65		

CMOS

CD4000	.39	CD4028	.89	CD4070	.55
CD4001	.39	CD4029	1.49	CD4071	.49
CD4002	.39	CD4030	.49	CD4072	.49
CD4006	1.19	CD4035	.99	CD4076	1.39
CD4007	.25	CD4040	1.49	CD4081	.39
CD4009	.49	CD4041	1.49	CD4082	.39
CD 040	.49	CD4042	.99	CD4093	.99
CD 041	.39	CD4043	.89	CD4098	1.19
D 042	.25	CD4044	.89	MC14409	14.95
C D13	.9	CD4046	1.79	MC14410	14.95
CD4014	1.39	CD4047	2.50	MC14411	14.95
CD4015	1.19	CD4048	1.35	MC14419	4.95
CD4016	.59	CD4049	.49	MC14433	13.95
CD4017	1.19	CD4050	.69	MC14506	.75
CD4018	.99	CD4051	1.19	MC14507	.99
CD4019	.49	CD4053	1.19	MC14562	11.95
CD4020	1.19	CD4056	2.95	MC14583	2.49
CD4021	1.39	CD4059	9.95	CD4508	3.95
CD4022	1.19	CD4060	1.49	CD4510	1.39
CD4023	.29	CD4066	.79	CD4511	1.29
CD4024	.79	CD4068	.39	CD4515	2.95
CD4025	.23	CD4069	.45	CD4518	1.29
CD4026	2.95			CD4520	1.29
CD4027	.69			CD4566	2.25

74C00

74C00	.39	74C85	2.49	74C163	2.49
74C02	.39	74C90	1.95	74C164	2.49
74C04	.45	74C93	1.95	74C173	2.60
74C08	.49	74C95	1.95	74C192	2.49
74C10	.39	74C107	1.25	74C193	2.49
74C14	1.95	74C151	2.90	74C195	2.49
74C20	.39	74C154	3.00	74C922	7.95
74C30	.39	74C157	2.15	74C923	6.25
74C42	1.95	74C160	2.49	74C925	8.95
74C48	2.49	74C161	2.49	74C926	8.95
74C73	.89			80C95	1.50
74C74	.89			80C97	1.50

LINEAR

78MG	1.75	LM340K-18	1.35	LM710N	.79
LM106H	.99	LM340K-24	1.35	LM711N	.39
LM3 H	.80	LM340T-5	1.25	LM723N/H	.55
LM301CN/H	.35	LM340T-6	1.25	LM733N	1.00
LM302H	.75	LM340T-8	1.25	LM739N	1.19
LM304H	1.00	LM340T-12	1.25	LM741CN/H	.35
LM305H	.60	LM340T-15	1.25	LM741-14N	.39
LM307CN/H	.35	LM340T-18	1.25	LM747N/H	.79
LM308CN/H	1.00	LM340T-24	1.25	LM748N/H	.39
LM309H	1.10	LM358N	1.00	LM1310N	1.95
LM309K	1.25	LM370N	1.95	LM1458CN/H	.59
LM310CN	1.95	LM373N	3.25	MC1488N	1.95
LM311N/H	.90	LM377N	4.00	MC1489N	1.95
LM312H	1.95	LM380N	1.25	LM1496N	.95
LM317K	6.50	LM380CN	.99	LM1556V	1.75
LM318CN/H	1.50	LM381N	1.79	MC1741SCP	3.00
LM319N	1.30	LM382N	1.79	LM2111N	1.95
LM320K-5	1.35	NE501N	8.00	LM2901N	2.95
LM320K-5.2	1.35	NE510A	6.00	LM3053N	1.50
LM320K-12	1.25	NE529A	4.95	LM3065N	1.49
LM320K-15	1.35	NE531H/V	3.95	LM3900N(3401)	.59
LM320K-18	1.35	NE536T	6.00	LM3905N	1.49
LM320K-24	1.35	NE540	6.00	LM3909N	1.25
LM320T-5	1.25	NE544N	4.95	MC5558V	.59
LM320T-5.2	1.25	NE550N	1.30	8038B	4.95
LM320T-8	1.25	NE555V	.39	LM75450N	.49
LM320T-12	1.25	NE556N	.99	75451CN	.39
LM320T-15	1.25	NE560B	5.00	75452CN	.39
LM320T-18	1.25	NE565N/H	1.25	75453CN	.39
LM320T-24	1.25	NE566CN	1.75	75454CN	.39
LM323K-5	5.95	NE567V/H	.99	75491CN	.79
LM324N	1.49	NE570N	4.95	75492CN	.89
LM339N	.99	LM703CN/H	.69	75493N	.89
LM340K-5	1.35	LM709N/H	.29	75494CN	.89
LM340K-6	1.35			RC4136	1.25
LM340K-8	1.35			RC4151	3.95
LM340K-12	1.35			RC4194	4.95
LM340K-15	1.35			RC4195	4.49

74LS00 TTL

74LS00	.35	74LS51	.29	74LS139	1.05
74LS01	.35	74LS54	.29	74LS151	1.05
74LS02	.35	74LS55	.29	74LS155	1.05
74LS03	.35	74LS73	.54	74LS157	1.05
74LS04	.42	74LS74	.54	74LS160	1.15
74LS05	.42	74LS75	.71	74LS161	1.39
74LS08	.35	74LS76	.54	74LS162	1.25
74LS09	.42	74LS78	.49	74LS163	1.39
74LS10	.35	74LS83	1.05	74LS164	1.0
74LS11	.75	74LS85	1.50	74LS175	125
74LS13	.59	74LS86	.54	74LS181	2.49
74LS14	1.25	74LS90	.71	74LS190	1.39
74LS15	.35	74LS92	.90	74LS191	1.39
74LS20	.35	74LS93	.90	74LS192	1.39
74LS21	.35	74LS95	.99	74LS193	1.39
74LS22	.35	74LS96	1.15	74LS194	1.39
74LS26	.35	74LS107	.54	74LS195	1.39
74LS27	.35	74LS109	.54	74LS253	1.25
74LS28	.36	74LS112	.54	74LS257	1.05
74LS30	.35	74LS123	1.50	74LS258	1.75
74LS32	.42	74LS126	1.05	74LS260	.83
74LS37	.45	74LS132	.99	74LS279	.90
74LS40	.35	74LS136	.59	74LS367	.75
74LS42	1.05	74LS138	1.05	74LS368	.75
74LS47	1.05			74LS670	2.49

JE608 PROGRAMMER

2704/2708 EPROM PROGRAMMER

- 3 separate Display Registers: 8 LED's for Hex Key entries, 10 LED's (2"-2") for Address Register and 8 LED's for Data Memory Register. The Data Memory Register displays the content of the RAMs from the EPROM Chip.
- Development of microprocessor systems by means of a ribbon cable from the programmer panel test socket to the EPROM socket on the microprocessor board.
- Rapid checking verification of programmed data changes.
- User may move data from a master to RAM's or write into RAM's with keyboard entries.
- Allows manual stepping manipulation (up and down) at any address location.
- Stand-alone EPROM Programmer consisting of:
  A 19-key Hexadecimal Keyboard assembly, Programmer Board assembly with 4 power supplies and a LED/Test Socket Panel Board assembly. The Test Socket is zero force insertion type. Power requirements: 115VAC, 60Hz, 6W.
- Compact desk-top enclosure: Color-coordinated designer's case with light tan panels and molded end pieces in mocha brown. Size: 3¼"H x 11"W x 8¾"D. Weight: 5 lbs.

The JE608 EPROM Programmer is a completely self-contained unit which is independent of computer control and requires no additional systems for its operations. The EPROM can be programmed from the Hexadecimal Keyboard or from a pre-programmed EPROM. The JE608 Programmer can emulate a programmed EPROM by the use of its internal RAM circuits. This will allow the user to test or pretest a program, for a system, prior to programming a chip. Any changes in the program can be entered directly into the memory circuits with the Hexadecimal Keyboard so that rewriting the entire program will not be necessary. The JE608 Programmer contains a Programmer/Board with 25 IC's and including power supplies of: −5V, +5V, +12V and +26V. The Hexadecimal Keyboard and LED/Test Socket Panel Board are separate assemblies within the system.

JE608 KIT $399.95
JE608 Assembled and Tested $499.95

DISCRETE LEDS

XC556R	.200"	red	5/$1	MV50	.085"	red	6/$1	XC111R	.190"	red	5/$1
XC556G	.200"	green	4/$1	XC209R	.125"	red	5/$1	XC111G	.190"	green	4/$1
XC556Y	.2 "	yellow	4/$1	XC209G	.125"	green	4/$1	XC111Y	.190"	yellow	4/$1
XC556C	.200"	clear	4/$1	XC209Y	.125"	yellow	4/$1	XC111C	.190"	clear	4/$1
XC22R	.200"	red	5/$1	XC526R	.185"	red	5/$1				
XC22G	.200"	green	4/$1	XC526G	.185"	green	4/$1				
XC22Y	.200"	yellow	4/$1	XC526Y	.185"	yellow	4/$1				
MV10B	.170"	red	4/$1	XC526C	.185"	clear	4/$1				

INFRA-RED LED
¼"x¼"x1/16" flat 5/$1

DISPLAY LEDS

TYPE	POLARITY	HT	PRICE	TYPE	POLARITY	HT	PRICE
MAN 1	Common Anode-red	.270	2.95	MAN 6730	Common Anode-red ± 1	.560	.99
MAN 2	5 x 7 Dot Matrix-red	.300	495	MAN 6740	Common Cathode-red-D.D.	.560	.99
MAN 3	Common Cathode-red	.125	.25	MAN 6750	Common Cathode-red ± 1	.560	.99
MAN 4	Common Cathode-red	.187	1.95	MAN 6760	Common Anode-red	.560	.99
MAN 7G	Common Anode-green	.300	1.25	MAN 6780	Common Cathode-red	.560	.99
MAN 7Y	Common Anode-yellow	.300	.99	DL701	Common Anode-red ± 1	.300	.99
MAN 72	Common Anode-red	.300	.75	DL704	Common Cathode-red	.300	.99
MAN 74	Common Cathode-red	.300	1.25	DL707	Common Anode-red	.300	.99
MAN 82	Common Anode-yellow	.300	.49	DL728	Common Cathode-red	.500	1.49
MAN 84	Common Cathode-yellow	.300	.99	DL741	Common Anode-red	.600	1.25
MAN3620	Common Anode-orange	.300	.49	DL746	Common Anode-red ± 1	.630	1.49
MAN3630	Common Anode-orange ± 1	.300	.99	DL747	Common Anode-red	.600	1.49
MAN3640	Common Cathode-orange	.300	.99	DL749	Common Cathode-red ± 1	.630	1.49
MAN 4610	Common Anode-orange	.300	.99	DL750	Common Cathode-red	.600	1.49
MAN 4640	Common Cathode-orange	.400	.99	DL338	Common Cathode-red	.110	.35
MAN 4710	Common Anode-red	.400	.99	FND70	Common Cathode	.250	.69
MAN 4730	Common Anode-red ± 1	.400	.99	FND358	Common Cathode ± 1	.357	.99
MAN 4740	Common Cathode-red	.400	.99	FND359	Common Cathode	.357	.75
MAN 4810	Common Anode-yellow	.400	.99	FND503	Common Cathode(FND500)	.500	.99
MAN 4840	Common Cathode-yellow	.400	.99	FND507	Common Anode (FND510)	.500	.99
MAN 6610	Common Anode-orange-D.D.	.560	.99	5082-7730	Common Anode-red	.300	.99
MAN 6630	Common Anode-orange ± 1	.560	.99	HDSP-3400	Common Anode-red	.800	1.50
MAN 6640	Common Cathode-orange-D.D.	.560	.99	HDSP-3403	Common Cathode red	.800	1.50
MAN 6650	Common Cathode-orange ± 1	.560	.99	5082-7300	4 x 7 sgl. Digit-RHDP	.600	19.95
MAN 6660	Common Anode-orange	.560	.99	5082-7302	4 x 7 Sgl. Digit-LHDP	.600	19.95
MAN 6680	Common Cathode-orange	.560	.99	5082-7304	Overrange character (±1)	.600	15.00
MAN 6710	Common Anode-red-D.D.	.560	.99	5082-7340	4 x 7 Sgl. Digit-Hexadecimal	.600	22.50

RCA LINEAR

CA3013T	2.15	CA3082N	2.00
CA2023T	3.25	CA3083N	1.60
CA3035T	2.48	CA3086N	.85
CA3039T	1.35	CA3089N	3.75
CA3046N	1.30	CA3130T	1.39
CA3059N	3.25	CA3140T	1.25
CA3060N	3.25	CA3160T	1.25
CA3080T	1.25	CA3401N	.59
CA3081N	2.00	CA3600N	3.50

CALCULATOR CHIPS/DRIVERS

MM5725	$2.95
MM5738	2.95
DM8864	2.00
DM8865	1.00
DM8887	.75
DM8889	.75
9374 7-seg. LED driver	1.50
MM5309	4.95

CLOCK CHIPS

MM5309	4.95
MM5311	4.95
MM5312	4.95
MM5314	4.95
MM5316	6.95
MM5318	9.95
MM5369	2.95
MM5387/1998a	4.95
CT 7001	6.95

MOTOROLA

MC1408L7	4.95
MC1408L8	5.75
MC1439L	2.95
MC3022P	2.95
MC3 1P	3.50
MC4016(74416)	7.50
MC4024P	3.95
MC4040P	6.95
MC4044P	4.50

LOW PROFILE (TIN) SOCKETS

	1-24	25-49	50-100
8 pin LP	.17	.16	.15
14 pin LP	.20	.19	.18
16 pin LP	.22	.21	.20
18 pin LP	.29	.28	.27
20 pin LP	.34	.32	.30
22 pin LP	.37	.36	.35
24 pin LP	.38	.37	.36
28 pin LP	.45	.44	.43
36 pin LP	.60	.59	.58
40 pin LP	.63	.62	.61

SOLDERTAIL STANDARD (TIN)

	1-24	25-49	50-100
14 pin ST	.27	.25	.24
16 pin ST	.30	.27	.25
18 pin ST	.35	.32	.30
24 pin ST	.49	.45	.42
28 pin ST	.99	.90	.81
36 pin ST	1.39	1.26	1.15
40 pin ST	1.59	1.45	1.30

SOLDERTAIL (GOLD) STANDARD

	1-24	25-49	50-100
8 pin SG	.39	.35	.31
14 pin SG	.49	.45	.41
16 pin SG	.54	.49	.44
18 pin SG	.59	.53	.48
24 pin SG	.79	.75	.69
28 pin SG	1.10	1.00	.90
36 pin SG	1.65	1.40	1.26
40 pin SG	1.75	1.59	1.45

WIRE WRAP SOCKETS (GOLD) LEVEL #3

	1-24	25-49	50-100
8 pin WW	.59	.54	.49
10 pin WW	.69	.63	.58
14 pin WW	.79	.73	.67
16 pin WW	.85	.77	.70
18 pin WW	.99	.90	.81
20 pin WW	1.19	1.08	.99
22 pin WW	1.49	1.35	1.23
24 pin WW	1.39	1.26	1.14
28 pin WW	1.69	1.53	1.38
36 pin WW	2.19	1.99	1.79
40 pin WW	2.29	2.09	1.89

1/4 WATT RESISTOR ASSORTMENTS – 5%

ASST. 1	5 ea.	10 OHM 27 OHM	12 OHM 33 OHM	15 OHM 39 OHM	18 OHM 47 OHM	22 OHM 56 OHM	50 PCS	$1.75
ASST. 2	5 ea.	68 OHM 180 OHM	82 OHM 220 OHM	100 OHM 270 OHM	120 OHM 330 OHM	150 OHM 390 OHM	50 PCS	1.75
ASST. 3	5 ea.	470 OHM 1.2K	560 OHM 1.5K	680 OHM 1.8K	820 OHM 2.2K	1K 2.7K	50 PCS	1.75
ASST. 4	5 ea.	3.3K 8.2K	3.9K 10K	4.7K 12K	5.6K 15K	6.8K 18K	50 PCS	1.75
ASST. 5	5 ea.	22K 56K	27K 68K	33K 82K	39K 100K	47K 120K	50 PCS	1.75
ASST. 6	5 ea.	150K 390K	180K 470K	220K 560K	270K 680K	330K 820K	50 PCS	1.75
ASST. 7	5 ea.	1M 2.7M	1.2M 3.3M	1.5M 3.9M	1.8M 4.7M	2.2M 5.6M	50 PCS	1.75

ASST. 8R Includes Resistor Assortments 1-7 (350 PCS.) $9.95 ea.

$10.00 Min. Order — U.S. Funds Only
Calif. Residents Add 6% Sales Tax
Postage—Add 5% plus $1 Insurance (if desired)

Spec Sheets — 25¢
1980 Catalog Available — Send 41¢ stamp

FREE 1980 CATALOG

Jameco ELECTRONICS

PHONE ORDERS WELCOME
(415) 592-8097

MAIL ORDER ELECTRONICS — WORLDWIDE
1355 SHOREWAY ROAD, BELMONT, CA 94002
9/80 PRICES SUBJECT TO CHANGE

TELEPHONE/KEYBOARD CHIPS

AY-5-9100	Push Button Telephone Dialler	$14.95
AY-5-92	Repertory Dialler	14.95
AY-5-9500	CMOS Clock Generator	4.95
AY-5-2376	Keyboard Encoder (88 keys)	14.95
HD0165	Keyboard Encoder (16 keys)	7.95
74C922	Keyboard Encoder (16 keys)	7.95
74C923	Keyboard Encoder (20 keys)	6.25

ICM CHIPS

ICM7045	CMOS Precision Timer	24.95
ICM7205	CMOS LED Stopwatch/Timer	19.95
ICM7207	Oscillator Controller	7.50
ICM7208	Seven Decade Counter	19.95
ICM7209	Clock Generator	6.95

NMOS READ ONLY MEMORIES

MCM6571	128 X 9 X 7 ASCII Shifted with Greek	13.50
MCM6574	128 X 9 X 7 Math Symbol & Pictures	13.50
MCM6575	128 X 9 X 7 Alpha Control Char. Gen	13.50

MISCELLANEOUS

TL074CN	Quad Low Noise bi-fet Op Amp	2.49
TL494CN	Switching Regulator	4.49
TL496CP	Single Switching Regulator	1.75
11C90	Divide 10/11 Prescaler	19.95
95H90	Hi-Speed Divide 10/11 Prescaler	11.95
4N33	Photo-Darlington Opto-Isolator	3.95
MK50240	Top Octave Freq. Generator	17.50
DS0026CH	5Mhz 2-phase MOS clock driver	3.75
TIL308	.27" red num. display w/integ. logic chip	10.95
MM5320	TV Camera Sync. Generator	14.95
MM5330	4½ Digit DPM Logic Block (Special)	3.95
LD110/111	3½ Digit A/D Converter Set	25.00/set
MC14433P	3½ Digit A/D Converter	13. 95

LITRONIX ISO-LIT 1
Photo Transistor Opto-Isolator
(Same as MCT 2 or 4N25)
49¢ each

SN 76477
SOUND GENERATOR
Generates Complex Sounds
Low Power - Programmable
$3.95 each

TV GAME CHIP AND CRYSTAL
AY-3-8500-1 and 2.01 MHZ Crystal (Chip & Crystal includes score display, 6 games and select angles, etc. **7.95/set**

EXAR

XR205	$8.40			XR2242CP	1.50
XR210	4.40			XR2264	4.25
XR215	4.40			XR2556	3.20
XR320	1.55			XR2567	2.99
XR-L555	1.50	JE2206KB	19.95	XR3403	1.25
XR555	.39	XR1800	3.20	XR4136	1.25
XR556	.99	XR2206	4.40	XR4151	3.95
XR567CP	.99	XR2207	3.85	XR4194	1.45
XR567CT	1.25	XR2208	5.20	XR4202	3.60
XR1310P	1.95	XR2209	1.75	XR4212	2.05
XR1468CN	3.85	XR2211	5.25	XR4558	.75
XR1488	1.95	XR2212	4.35	XR4739	1.15
XR1489	1.95	XR2240	3.45	XR4741	1.47

DIODES

TYPE	VOLTS	W	PRICE	TYPE	VOLTS	W	PRICE
				1N4002	100 PIV	1 AMP	12/1.00
				1N4003	200 PIV	1 AMP	12/1.00
1N746	3.3	400m	4/1.00	1N4004	400 PIV	1 AMP	12/1.00
1N751	5.1	400m	4/1.00	1N4005	600 PIV	1 AMP	10/1.00
1N752	5.6	400m	4/1.00	1N4006	800 PIV	1 AMP	10/1.00
1N753	6.2	400m	4/1.00	1N4007	1000 PIV	1 AMP	10/1.00
1N754	6.8	400m	4/1.00	1N3600	50	200m	6/1.00
1N757	9.0	400m	4/1.00	1N4148	75	10m	15/1.00
1N759	12.0	400m	4/1.00	1N4154	35	10m	12/1.00
1N959	8.2	400m	4/1.00	1N4733	5.1	1w	28
1N965	15	400m	4/1.00	1N4734	5.6	1w	28
1N5232	5.6	500m	28	1N4735	6.2	1w	28
1N5234	6.2	500m	28	1N4736	6.8	1w	28
1N5235	6.8	500m	28	1N4736	8.2	1w	28
1N5236	7.5	500m	28	1N4742	12	1w	28
1N5242	12	500m	28	1N4744	15	1w	28
1N5245	15	500m	28	1N1183	50 PIV	35 AMP	1.60
1N456	25	40m	6/1.00	1N1184	100 PIV	35 AMP	1.70
1N458	150	7m	6/1.00	1N1185	150 PIV	35 AMP	1.70
1N485A	180	10m	5/1.00	1N1186	200 PIV	35 AMP	1.80
1N4001	50 PIV	1 AMP	12/1.00	1N1188	400 PIV	35 AMP	3.00

SCR AND FW BRIDGE RECTIFIERS

C36D	15A @ 400V	SCR(2N1849)	$1.95
C36M	35A @ 600V	SCR	1.95
2N2328	1.6A @ 300V	SCR	.50
MDA 980-1	12A @ 50V	FW BRIDGE REC.	1.95
MDA 980-3	12A @ 200V	FW BRIDGE REC.	1.95

TRANSISTORS

C106B1	.50			2N3904	4/1.00
MPSA05	.30	2N3055	.89	2N3905	4/1.00
MPSA06	5/1.00	MJE3055	1.00	2N3906	4/1.00
TIS97	6/1.00	2N3392	5/1.00	2N4013	3/1.00
TIS98	6/1.00	2N3398	5/1.00	2N4123	6/1.00
40409	1.75	PN3567	3/1.00	PN4249	4/1.00
40410	1.75	PN3568	4/1.00	PN4250	4/1.00
40673	1.75	PN3569	4/1.00	2N4400	4/1.00
2N918	4/1.00	MPS3638A	5/1.00	2N4401	4/1.00
2N2219A	2/1.00	MPS3702	5/1.00	2N4402	4/1.00
2N2221A	4/1.00	2N3704	5/1.00	2N4403	4/1.00
2N2222A	5/1.00	MPS3704	5/1.00	2N4409	5/1.00
PN2222 Plastic	7/1.00	2N3705	5/1.00	2N5086	4/1.00
2N2369A	4/1.00	MPS3705	5/1.00	2N5087	4/1.00
MPS2369	5/1.00	2N3706	5/1.00	2N5088	4/1.00
2N2484	4/1.00	MPS3706	5/1.00	2N5089	4/1.00
2N2906	4/1.00	2N3707	5/1.00	2N5129	5/1.00
2N2907	5/1.00	2N3711	5/1.00	PN5134	5/1.00
		2N3724A	.65	PN5138	5/1.00
2N2925	5/1.00	2N3725A	1.00	2N5139	5/1.00
MJE2955	1.25	2N3772	2.25	2N5210	5/1.00
2N3053	2/1.00	2N3823	1.00	2N5449	3/1.00
		2N3903	5/1.00	2N5951	3/1.00

CAPACITOR CORNER

50 VOLT CERAMIC DISC CAPACITORS

	1-9	10-99	100+		1-9	10-99	100+
10 pf	.05	.04	.03	.001µF	.05	.04	.035
22 pf	.05	.04	.03	.0047µF	.05	.04	.035
47 pf	.05	.04	.03	.01µF	.05	.04	.035
100 pf	.05	.04	.03	.022µF	.06	.05	.04
220 pf	.05	.04	.03	.047µF	.06	.05	.04
470pf	.05	.04	.035	.1µF	.12	.09	.075

100 VOLT MYLAR FILM CAPACITORS

	1-9	10-99	100+		1-9	10-99	100+
.001mf	.12	.10	.07	.022mf	.13	.11	.08
.0022	.12	.10	.07	.047mf	.21	.17	.13
.0047mf	.12	.10	.07	.1mf	.27	.23	.17
.01mf	.12	.10	.07	.22mf	.33	.27	.22

+20% DIPPED TANTALUMS (SOLID) CAPACITORS

	1-9	10-99	100+		1-9	10-99	100+
.1/35V	.39	.31	.25	1.5/35V	.41	.33	.26
.15/35V	.39	.31	.25	2.2/35V	.51	.41	.33
.22/35V	.39	.31	.25	3.3/25V	.53	.43	.34
.33/35V	.39	.31	.25	4.7/25V	.63	.51	.41
.47/35V	.39	.31	.25	6.8/25V	.79	.63	.50
.68/35V	.39	.31	.25	15/25V	1.39	1.12	.89
1.0/35V	.39	.31	.25	22/6V	.79	.63	.50

MINIATURE ALUMINUM ELECTROLYTIC CAPACITORS

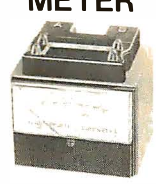
Axial Lead	1-9	10-99	100+	Radial Lead	1-9	10-99	100+
.47/50V	.15	.13	.10	.47/25V	.15	.13	.10
1.0/50V	.16	.14	.11	.47/50V	.16	.14	.11
3.3/50V	.14	.12	.09	1.0/16V	.15	.13	.10
4.7/25V	.15	.13	.10	1.0/25V	.16	.14	.11
10/25V	.15	.13	.10	1.0/50V	.16	.14	.11
10/50V	.16	.14	.12	4.7/16V	.15	.13	.10
22/25V	.17	.15	.12	4.7/25V	.15	.13	.10
22/50V	.24	.20	.18	4.7/50V	.16	.14	.11
47/25V	.19	.17	.15	10/16V	.14	.12	.09
47/50V	.25	.21	.19	10/25V	.15	.13	.10
100/25V	.24	.20	.18	10/50V	.16	.14	.12
100/50V	.35	.30	.28	47/50V	.24	.21	.19
220/25V	.32	.28	.25	100/16V	.19	.15	.14
220/50V	.45	.41	.38	100/25V	.24	.20	.18
470/25V	.33	.29	.27	100/50V	.35	.30	.28
1000/16V	.55	.50	.45	220/16V	.23	.17	.16
2200/16V	.70	.62	.55	470/25V	.31	.28	.26

Circle 348 on inquiry card.



ULTRAVIOLET INTENSITY METER

by BLAK-RAY



TWO MODELS:
LONG WAVE
AND
SHORT WAVE

Meter consists of a sensor cell attached to a compact (3" x 3¼" x 3") metering unit. Can be hand-held or placed directly on surface for measuring. Can be used remotely, while connected to a meter housing by a 4-foot extension cord. Two models available — one for long wave and one for short wave ultraviolet. Readings are in microwatts per square centimeter. Weight: 1 lb.

Completely assembled (includes sensor cell, reduction screen, extension cord, contrast filter and certification report.)

J-221 LONG WAVE (300nm-400nm) **$242.00**

J-225 SHORT WAVE (200nm-280nm) **$260.00**

EPROM Erasing Lamp



- Erases 2708, 2716, 1702A, 5203Q, 5204Q, etc.
- Erases up to 4 chips within 20 minutes
- Maintains constant exposure distance of one inch
- Special conductive foam liner eliminates static build-up
- Built-in safety lock to prevent UV exposure
- Compact — only 7-5/8" x 2-7/8" x 2"
- Complete with holding tray for 4 chips

UVS-11E $69.95

Jumbo 6-Digit Clock Kit

* Four .630"ht. and two .300"ht. common anode displays
* Uses MM5314 clock chip
* Switches for hours, minutes and hold functions
* Hours easily viewable to 30 feet
* Simulated walnut case
* 115VAC operation
* 12 or 24 hour operation
* Includes all components, case and wall transformer
* Size: 6¾ x 3⅛ x 1¾

JE747 .... $29.95



- Bright .300 ht. comm. cathode display
- Uses MM5314 clock chip
- Switches for hours, minutes and hold modes
- Hrs. easily viewable to 20 ft.
- Simulated walnut case
- 115 VAC operation
- 12 or 24 hr. operation
- Incl. all components, case & wall transformer
- Size: 6¾" x 3-1/8" x 1¾"

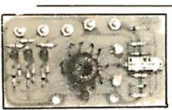
JE701

6-Digit Clock Kit $19.95

Regulated Power Supply

Uses LM309K. Heat sink provided. PC board construction. Provides a solid 1 amp @ 5 volts. Can supply up to ±5V, ±9V and ±12V with JE205 Adapter. Includes components, hardware and instructions. Size: 3½" x 5" x 2"H

JE200....... $14.95



ADAPTER BOARD — Adapts to JE200— ±5V, ±9V and ±12V

DC/DC converter with +5V input. Toriodal hi-speed switching XMFR. Short circuit protection. PC board construction. Piggy-back to JE 200 board. Size: 3½" x 2" x 9/16"H

JE205 .... $12.95

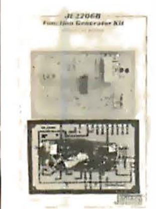
MICROPROCESSOR COMPONENTS

8080A/8080A SUPPORT DEVICES		
8080A	CPU	$ 7.95
8212	8-Bit Input/Output	3.25
8214	Priority Interrupt Control	5.95
8216	Bi-Directional Bus Driver	3.49
8224	Clock Generator/Driver	3.95
8226	Bus Driver	3.49
8228	System Controller/Bus Driver	4.95
8238	System Controller	5.95
8251	Prog. Comm. I/O (USART)	7.95
8253	Prog. Interval Timer	14.95
8255	Prog. Periph. I/O (PPI)	9.95
8257	Prog. DMA Control	19.95
8259	Prog. Interrupt Control	19.95
6800/6800 SUPPORT DEVICES		
MC6800	MPU	$14.95
MC6802CP	MPU with Clock and Ram	24.95
MC6810API	128X8StaticRam	5.95
MC6821	Periph. Inter. Adapt (MC6820)	7.49
MC6828	Priority Interrupt Controller	12.95
MC6830L8	1024X8 Bit ROM (MC68A30-8)	14.95
MC6850	Asynchronous Comm. Adapter	7.95
MC6852	Synchronous Serial Data Adapt.	9.95
MC6860	0-600 bps Digital MODEM	12.95
MC6862	2400 bps Modulator	14.95
MC6880A	Quad 3-State Bus. Trans. (MC8T26)	2.25
MICROPROCESSOR CHIPS—MISCELLANEOUS		
Z80(780C)	CPU	$13.95
Z80A(780-1)	CPU	15.95
COP1802	CPU	19.95
2650	MPU	19.95
6502	CPU	11.95
8035	8-Bit MPU w/clock, RAM, I/O lines	19.95
P8085	CPU	19.95
TMS9900JL	16-Bit MPU w/hardware, multiply & divide	49.95
SHIFT REGISTERS		
MM500H	Dual 25 Bit Dynamic	$.50
MM503H	Dual 50 Bit Dynamic	.50
MM504H	Dual 16 Bit Static	.50
MM506H	Dual 100 Bit Static	.50
MM510H	Dual64 Bit Accumulator	.50
MM5016H	500/512 Bit Dynamic	.89
2504T	1024 Dynamic	3.95
2518	Hex 32 Bit Static	4.95
2522	Dual 132 Bit Static	2.95
2524	512 Static	.99
2525	1024 Dynamic	2.95
2527	Dual 256 Bit Static	2.95
2528	Dual250 Static	4.00
2529	Dual 240 Bit Static	4.00
2532	Quad 80 Bit Static	2.95
3341	Fifo	6.95
74LS670	4X4 Register File (TriState)	2.49
UART'S		
A-Y-5-1013	30K BAUD	5.95

MICROPROCESSOR MANUALS		
M-Z80	User Manual	$7.50
M-COP1802	User Manual	7.50
M-2650	User Manual	5.00
ROM'S		
2513(2140)	Character Generator(upper case)	$9.95
2513(3021)	Character Generator(lower case)	9.95
2516	Character Generator	10.95
MM5230N	2048-Bit Read Only Memory	1.95

RAM'S			
1101	256X1	Static	$1.49
1103	1024X1	Dynamic	.99
2101(8101)	256X4	Static	3.95
2102	1024X1	Static	1.75
21L02	1024X1	Static	1.95
2111(8111)	256X4	Static	3.95
2112	256X4	Static MOS	4.95
2114	1024X4	Static 450ns	7.95
2114L	1024X4	Static450ns low power	10.95
2114-3	1024X4	Static 300ns	10.95
2114L-3	1024X4	Static 300ns low power	11.95
5101	256X4	Static	7.95
5280/2107	4096X1	Dynamic	4.95
7489	16X4	Static	1.75
74S200	256X1	Static Tristate	4.95
93421	256X1	Static	2.95
UPD414 (MK4027)	4K	Dynamic 16 pin	4.95
UPD416 (MK4116)	16K	Dynamic 16pin 250ns	7.95
TMS4044-45NL	4K	Static	14.95
TMS4045	1024X4	Static	14.95
2117	16.384X1	Dynamic 350ns (house marked)	9.95
MM5262	2KX1	Dynamic	4/1.00
PROM'S			
1702A	2048	FAMOS	$5.95
2716INTEL	16K*	EPROM	59.95
TMS2516	16K*	EPROM	24.95
(2716)	*Requires single +5V power supply		
TMS2532	4KX8	EPROM	89.95
2708	8K	EPROM	10.95
2716T.I	16K**	EPROM	29.95
	**Requires 3 voltages, —5V, +5V, +12V		
5203	2048	FAMOS	14.95
6301-1(7611)	1024	Tristate Bipolar	3.49
6330-1(7602)	256	Open C Bipolar	2.95
82S23	32X8	Open Collector	3.95
82S115	4096	Bipolar	19.95
82S123	32X8	Tristate	3.95
74186	512	TTL Open Collector	9.95
74188	256	TTL Open Collector	3.95
74S287	1024	Static	2.95

Function Generator Kit



Provides 3 basic waveforms: sine, triangle and square wave. Freq. range from 1 Hz to 100K Hz. Output amplitude from 0 volts to over 6 volts (peak to peak). Uses a 12V supply or a ±6V split supply. Includes chip, P.C. Board, components & instructions.

JE2206B....$19.95

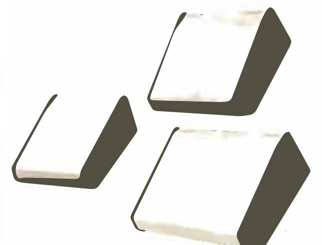
DIGITAL THERMOMETER KIT



- Dual sensors—switching control for indoor/outdoor or dual monitoring
- Continuous LED .8" ht. display
- Range: -40°F to 199°F / -40°C to 100°C
- Accuracy: ± 1° nominal
- Set for Fahrenheit or Celsius reading
- Sim. walnut case - AC wall adapter incl.
- Size: 3-1/4"H x 6-5/8"W x 1-3/8"D

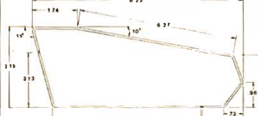
JE300 ....$39.95

DESIGNERS' SERIES
Blank Desk-Top Electronic Enclosures



- High strength epoxy molded end pieces in mocha brown finish.
- Sliding rear/bottom panel for service and component accessibility.
- Top/bottom panels.080 thk alum. Alodine type 1200 finish (gold tint color) for best paint adhesion after modification.
- Vented top and bottom panels for cooling efficiency.
- Rigid construction provides unlimited applications.

CONSTRUCTION:
The "DTE" Blank Desk Top Electronic Enclosures are designed to blend and complement today's modern computer equipment and can be used in both industrial and home. The end pieces are precision molded with an internal slot (all around) to accept both top and bottom panels. The panels are then fastened to ¼" thick tabs inside the end pieces to provide maximum rigidity to the enclosure. For ease of equipment servicing, the rear/bottom panel slides back on slotted tracks while the rest of the enclosure remains intact. Different panel widths may be used while maintaining a common profile outline. The molded end pieces can also be painted to match any panel color scheme.



Enclosure Model No.	Panel Width	PRICE
DTE-8	8.00"	$29.95
DTE-11	10.65"	$32.95
DTE-14	14.00"	$34.95

$10.00 Min. Order — U.S. Funds Only
Calif. Residents Add 6% Sales Tax
Postage—Add 5% plus $1 Insurance (if desired)

Spec Sheets — 25¢
1980 Catalog Available — Send 41¢ stamp



PHONE ORDERS WELCOME
(415) 592-8097

MAIL ORDER ELECTRONICS — WORLDWIDE
1355 SHOREWAY ROAD, BELMONT, CA 94002
PRICES SUBJECT TO CHANGE

9/80

The Incredible
"Pennywhistle 103"

$139.95 Kit Only

The Pennywhistle 103 is capable of recording data to and from audio tape without critical speed requirements for the recorder and it is able to communicate directly with another modem and terminal for telephone "hamming" and communications. In addition, it is free of critical adjustments and is built with non-precision, readily available parts.

Data Transmission Method .....Frequency-Shift Keying, full-duplex (half-duplex selectable).
Maximum Data Rate..........300Baud.
Data Format ....Asynchronous Serial (return to mark level required between each character).
Receive Channel Frequencies . ..2025 Hz for space; 2225 Hz for mark.
Transmit Channel Frequencies ..Switch selectable: Low (normal) = 1070 space, 1270 mark; High = 025 space, 2225 mark.
Receive Sensitivity ....−46dbm accoustically coupled.
Transmit Level ....−15 dbm nominal. Adjustable from −6 dbm to −20 dbm.
Receive Frequency Tolerance ...Frequency reference automatically adjusts to allow for operation between 1800 Hz and 2400 Hz.
Digital Data Interface ....EIA RS-232C or 20 mA current loop (receiver is optoisolated and non-polar).
Power Requirements ....120 VAC, single phase, 10 Watts.
Physical.......................All components mount on a single 5" by 9" printed circuit board. All components included.

Requires a VOM, Audio Oscillator, Frequency Counter and/or Oscilloscope to align.

TRS-80
16K Conversion Kit

Expand your 4K TRS-80 System to 16K.
Kit comes complete with:
* 8 each UPD416-1 (16K Dynamic Rams) 250NS
* Documentation for conversion

TRS-16K $59.95

JE610 ASCII Encoded Keyboard Kit



The **JE610 ASCII Keyboard Kit** can be interfaced into most any computer system. The kit comes complete with an industrial grade keyboard switch assembly (62-keys), IC's, sockets, connector, electronic components and a double-sided printed wiring board. The keyboard assembly requires +5V @ 150mA and −12V @ 10mA for operation. Features: 60 keys generate the full 128 characters, upper and lower case ASCII set. Fully buffered. Two user-define keys provided for custom applications. Caps lock for upper-case-only alpha characters. Utilizes a 2376 (40-pin) encoder read-only memory chip. Outputs directly compatible with TTL/DTL or MOS logic arrays. Easy interfacing with a 16-pin dip or 18-pin edge connector.

JE610 (Case not included) **$79.95**

Desk-Top Enclosure for JE610 ASCII Encoded Keyboard Kit

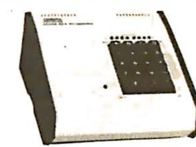
Compact desk-top enclosure: Color-coordinated designer's case with light tan aluminum panels and molded end pieces in mocha brown. Includes mounting hardware. Size: 3½"H x 14½"W x 8¾"D.

DTE-AK $49.95

SPECIAL: JE610/DTE-AK PURCHASED TOGETHER (Value $129.90) $124.95

JE600 Hexadecimal Encoder Kit

FULL 8-BIT LATCHED OUTPUT 19-KEY KEYBOARD



The **JE600** Encoder Keyboard Kit provides two separate hexadecimal digits produced from sequential key entries to allow direct programming for 8-bit microprocessor or 8-bit memory circuits. Three additional keys are provided for user operations with one having a bistable output available. The outputs are latched and monitored with 9 LED readouts. Also included is a key entry strobe. Features: Full 8-bit latched output for microprocessor use. Three user-define keys with one being bistable operation. Debounce circuit provided for all 19 keys. 9 LED readouts to verify entries. Easy interfacing with standard 16-pin IC connector. Only +5VDC required for operation.

JE600 (Case not included) **$59.95**

Desk-Top Enclosure for JE600 Hexadecimal Keyboard Kit

Compact desk-top exclosure: Color-coordinated designer's case with light tan aluminum panels and molded end pieces in mocha brown. Includes mounting hardware. Size: 3½"H x 8¼"W x 8¾"D.

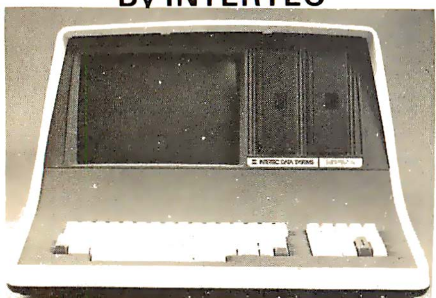
DTE-HK $44.95

SPECIAL: JE600/DTE-HK PURCHASED TOGETHER (Value $104.90) $99.95

Circle 348 on inquiry card.

Computers, Disk Systems

SUPERBRAIN®
By INTERTEC



32K or 64K (Double or Quad Density units available). Uses two Z-80 CPU's. Commercial-type terminal with 12" monitor. Dual double density minifloppies. Over 350 kilobytes of storage (twice that with quad density drives). Two serial RS232 ports, I/O ports standard. Expandable with optional S-100 S-100 interface. Comes with CP/M™ 2.2 operating system. MiniMicroMart includes BASIC interpreter and can supply a wide range of CP/M Development and Application software.

w/32K Double Density, List $2995 . **$2685**
w/64K Double Density, List $3345 ..... **$2883**
w/64K Quad Density, List $3995 ...... **$3595**
W/64K Quad — MiniMicroMart Upgrade Special.................... **$3395**

MICROMATION



A 64K complete computer with dual density 8" floppies (1 megabyte). Rack or vertical mounting. Systems with double-sided drives, hard disks, and multi-user (MP/M).
Z+100 64K RAM, Computer, $2495. . **$2099**
Z+120 Includes two 8" disks, $4995 ... $4199
"Z" system features new distributed processing multi-user concept with one Z-80 per user, with Z-80 for MP/M (Master Satellite concept).
AS LOW AS $11,899!

SD SYSTEMS

SDS-100, w/32K RAM, $6995 ..... **$5945**
SDS-200, List $8995 .... $7645

RADIO SHACK TRS-80™

10% OFF!



INTERSYSTEMS
formerly ITHACA AUDIO



DPS-1, List $1795

Call for Price!

The new Series II CPU Board features a 4 MHz Z-80A CPU and a full-feature front panel. 20-slot actively terminated motherboard, with 25 amp power supply (50/60 Hz operation, incl. 68 cfm fan).

COMPLETE SYSTEM with InterSystem 64K RAM, I/O Board w/priority interrupt and double density disk controller board. Full 1-year warranty, List $3595

Call for Price!

HEWLETT-PACKARD
HP-85A

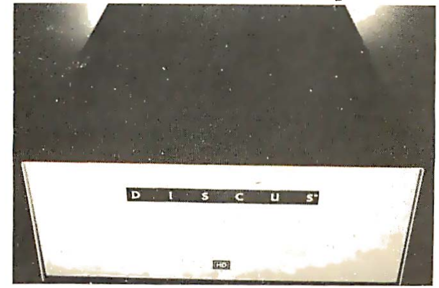
Desk-Top Computer

Call for Price



MORROW
THINKER TOYS®
DISCUS M26™

26 megabytes of formatted storage
List $4,995 **$4,199**



THINKER TOYS®
DISK SYSTEMS

Now includes CP/M® 2.2
Discus 2D, List $1199...... **$1019**
Discus 2D, dual-drive, List $1994 ...... **$1694**
Discus 2+2, Assem., List $1549....... **$1319**
Dual Discus 2+2, Assem., $2748...... **$2335**
All Morrow systems now include CP/M® 2.2

NORTH STAR DOUBLE DENSITY CONTROLLER BOARDS

Kit, List $399
OUR PRICE **$329**
Assembled and Tested, List $499........ **$399**

In Stock — First Time in 2 Years!

FANTASTIC SAVINGS on a "QUAD" DENSITY HORIZON UPGRADE

North Star Double Density Controller Board (see above) and a quad density MPI-52 (features superior disk handling and door mechanism.

MDS-H-MQ/K Kit form
List $999 OUR PRICE **$699**
MDS-H-MQ/A Assembled form, List $1099 **$759**
Shipping and insurance: Add $6.

NORTH STAR MDS-A Double Density Mini Floppy Disk System

Double Density, Kit
List $799 OUR PRICE **$669**
Assembled and Tested........ **$719**
Quad Version, Kit, List....... **$836**
Assembled, List $1099......... **$896**
Above MDS-A units do not include cabinet or power supply.
Shipping and Insurance: Add $7.50.

Super Special!

North Star Controller Board, Drive, Cabinet, and Power Supply **$709**

Complete system similar to above but also includes a cabinet and an assembled/tested power supply for the drive (silver finish). Your choice of Shugart SA-400 or MPI-51 Double Density Drive or MPI-52 quad density drive (MPI drives feature improved door and disk handling mechanism).

w/Controller Bd. kit, SA-400........... **$709**
w/Controller Bd. kit, MPI-51........... **$709**
w/Controller Bd. kit, MPI-52........... **$809**
w/Assembled Bd. and SA-400.......... **$769**
w/Assembled Bd. and MPI-51.......... **$769**
w/Assembled Bd. and MPI-52.......... **$869**
Shipping and Insurance: Add $6.

For converting existing Horizon 2 to quad, order additional MPI-52
MPI-52 Quad Density Drive **$379**

Circle 349 on inquiry card.

Terminals and Printers!

TELEVIDEO TVI-912C



Upper and lower case, 15 baud rates: 75 to 19,000 baud, dual intensity, 24 x 80 character display, 12 x 10 resolution. Numeric pad. Programmable reversible video, auxiliary port, self-test mode, protect mode, block mode, tabbing, addressable cursor. Microprocessor controlled, programmable underline, line and character insert/delete. "C" version features typewriter-style keyboard. List $950

OUR PRICE $789

920C (with 11 function keys, 6 edit keys and 2 transmission mode keys, List $1030

ONLY $849

Intertec

EMULATOR

Software compatible with a Soroc IQ-120, Hazeltine 1500, ADM-3A or DEC VT-52. Features block mode transmission and printer port; 12" anti-glare screen; 18-key numeric keypad; full cursor control. List $895

OUR PRICE $729



Intertec **INTERTUBE II**

List $995 **ONLY $799**

12" display, 24 x 80 format, 18-key numeric keypad, 128 upper/lower case ASCII characters. Reverse video, blinking, complete cursor addressing and control. Special user-defined control function keys, protected and unprotected fields. Line insert/delete and character insert/delete editing, eleven special line drawing symbols.

SOROC



IQ-120

List $995

SPECIAL

$729

IQ-140 List $1495

SPECIAL $1149

HAZELTINE

1500

ONLY

$879



1410 w/numeric keypad, List $900	$749
1420 w/lower case and numeric pad	849
1510, List $1395	1089
1520, List $1650	1389

BANTAM 550

From Perkin-Elmer



ONLY

$799

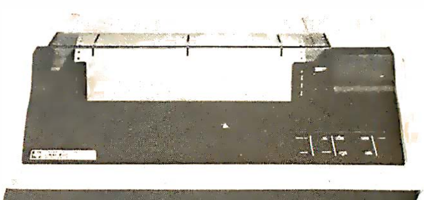
with anti-glare CRT **ONLY $829**

CENTRONICS

PRINTERS

NEW 730, parallel, friction, tractor ...	**$679**
NEW 737 parallel, friction, tractor	**$849**
779-2 w/tractor (same as TRS-80 Line Printer I), List $1350	1049
702 120 cps, bi-direct., tractor, VFU	1995
703 185 cps, bi-direct., tractor, VFU	2395
704 RS232 serial version of 703, $2350 ..	$1995

TI-810



TI-810 Basic Unit, $1895 .	**ONLY $1695**
TI-810 w/full ASCII (Lower case), vertical forms control, and compressed print .	**$1895**
TI-745 Complete printing terminal with acoustic coupler, List $1695	**$1399**

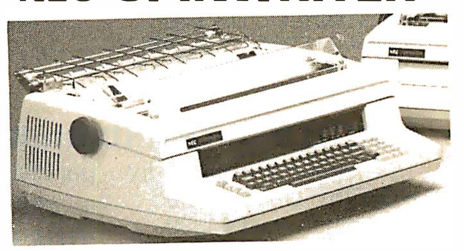
PAPER TIGER®





IDS-440 Paper Tiger, List $995 .	**$895**
w/graphics option, incl. buffer, $1194 ..	**$989**
TRS-80 cable	**45**

NEC SPINWRITER™



Terminal/Keyboard as well as RO Printer Only models available.

CALL FOR PRICES!

OKIDATA Microline 80	**ONLY $649**
Tractor Feed Option	**$99**
Serial interface	**$89**
AXIOM IMP I	**$699**
COMPRINT 912 w/parallel interf.	**$559**
912 w/serial interface, List $699	**$589**
MICROTEK, List $750	**$675**
ANADEX 80-Col. Dot Matrix.....	**$849**

Above prices reflect a 2% cash discount (order prepaid prior to shipment). Add 2% to prices for credit card orders, C.O.D.'s, etc. Prices are f.o.b. shipping point. Prices are subject to change and offers subject to withdrawal without notice. **WRITE FOR FREE CATALOG.**

Circle 350 on inquiry card.

MiniMicroMart, Inc.



1618 James Street, Syracuse NY 13203 (315) 422-4467 TWX 710-541-0431

If North Star or Cromemco offer it . . .

WE HAVE IT!!

Immediate Delivery at Discount Price



NORTH STAR
Horizon® 2
32K Double Density
Assembled and Tested
List $3095
ONLY $2619

North Star KIT products have been discontinued. MiniMicroMart HAS INVENTORY of most items!

KITS		ASSEMBLED	
HORIZON 1 16K, DD	**$1474**	**HORIZON 1**, DD	**$2279**
32K, DD, List $1999	**1684**	32K, QD, List $2995	**2539**
32K, QD, List $2199	**1869**	**HORIZON 2**, 32K, DD	**$2619**
HORIZON 2, 16K, DD	**$1824**	32K, QD, List $3595	**3049**
32K, DD, List $2399	**2034**	48K, DD, List $3590	**3039**
32K, QD, List $2779	**2359**	48K, QD, List $4090	**3469**
		64K, DD, List $3830	**3239**
		64K, QD, List $4330	**3669**

NORTH STAR APPLICATIONS SOFTWARE
(Exclusive for use with North Star Disk Systems — specify Double or Quad Density)

NORTHWORD, List $399	$339
MAILMANAGER, List $299	249
INFOMANAGER, List $499	419
GENERALLEDGER, List $999	799
ACCOUNTSRECEIVABLE, List $599	499
ACCOUNTSPAYABLE, List $599	499

NORTH STAR HARD DISK HD-18
18 megabytes, plugs into parallel port of North Star Horizon. Utilizes tried-and-proven 14" Century Data Marksman. List $4999. **OUR PRICE $4199**

NORTH STAR MDS-A — Double (or Quad) Density Disk System, Kit, List $799 . **OUR PRICE $669**
Assembled and Tested, List $899 **SPECIAL $719**

NORTH STAR MEMORY BOARDS
16K Dynamic RAM (RAM-16-A/A), Assembled, List $499 ..... **$420**
Kit, List $449 ..... **SPECIAL $299**
32K (RAM-32/A), Assembled, List $739 ..... **$620**
Kit, List $669 ..... **ONLY $499**

NEW System
by CROMEMC
Now with Du
Double Sid
Double Densi
(over 2 megabyt
of Storag
64K of RA
List $73

LIMITED TIME INTRODUCTORY SPECIAL **$6199**

CROMEMCO SYSTEM 2 — Now features du sided drives — double the capacity. Similar to System except features dual, double-sided mini floppy di drives. List $3990 ..... **ONLY $33**

Z-2 COMPUTER SYSTEM (can be rack mounted), List $995 ..... **$8**

SINGLE CARD COMPUTER — SCC-W
4 MHz. List $450 ..... **$3**

***NEW* COLOR GRAPHICS INTERFACE — SDI**
List $595 ..... ***OUR PRICE ONLY $5***

CROMEMCO HDD – 11/22-megabyte Hard Di for use with existing systems. DMA controller. Tra fer rate of 5.6 megabytes/second.
HDD-11, List $6995 ..... **OUR PRICE ONLY $59**
HDD-22, List $11,995 ..... **$10,**

CROMEMCO Z-2H Full 11-megabyte Hard D system. Fast Z-80 4 MHz process two floppy d drives, 64K RA memory, RS2 special interfa printer interfa and extensi software availab
List $99
OUR PRICE $84

SHIPPING AND INSURANCE: Add $15 or Horizons, $2.50 for Boards and Software. Hard Disk Systems and Cromemco systems shipped freight colle Advertised prices are for prepaid orders. Credit card and C.O.D. 2% higher. Deposit may be required on C.O.D. All prices subject to change and off subject to withdrawal without notice.

— WRITE FOR FREE CATALOG —

MiniMicroMart, Inc.

1618 James Street, Syracuse, NY 13203 (315) 4 -4467 TWX 710-541-0431

master char
VISA

Circle 351 on inquiry card.

Try to beat our prices!

SUPERBRAIN® by Intertec



Self-contained computer with dual disks and two RS232C ports. Complete with CP/M® 2.2 and BASIC.

32K Double Density, List $2995 . **$2685**
64K Double Density, List $3345 .... $2883
64K MiniMicroMart-upgraded to Quad Density .... ***SPECIAL $3395***

VIDEO TERMINALS

NEW **EMULATOR (Intertec)**, List $895 $ 729
INTERTUBE II, List $995 ...... ONLY $ 799
SOROC 120, List $995 ...... ***SPECIAL $ 729***
IQ140, List $1495 .... ***SPECIAL $1149***
PERKIN-ELMER 550, List $997 ...... $ 799
with anti-glare screen, $1027 .... $ 829
HAZELTINE 1410, List $900 .... $ 749
1420 .... $ 849
1500, List $1225 .... $ 879
1510, List $1395 .... $1089
1520, List $1650 .... $1389
ADDS R-20, List $995 .... $ 945
LEAR SIEGLER ADM3A, Assembled .. $ 849
TELEVIDEO 912C, List $950 .... $ 789
920C, List $1030 .... $ 849

PRINTERS

ANADEX DP-8000 .... $ 849
DP-9500, List $1650 .... $1399
INTEGRAL DATA IP-125 w/1210 ..... $ 724
IP-225 w/1210 & 1250 op., List $988 ... $ 834
IP-225 w/tractor, 1210, 1250, 1221 (2K Buffer), 1241 (graphics) ... NOW $ 899
PAPER TIGER IDS-440, List $995 .... $ 895
w/graphics op., incl. buffer, $1195 ... $ 989
NEC Spinwriters .... Call for Price
TELETYPE 43 KSR $1087
CENTRONICS
730-1 parallel interface .... ***NEW LOW $679***
737 parallel interface .. ***SUPER VALUE $849***
779 w/Tractor, List $1350 .... $1049
702 w/Tractor, VFU, List $2480 ...... $1995
703 w/Tractor, VFU, List $2975 ...... $2395
704 w/Tractor, VFU, List $2350 ...... $1995
TI 810 Basic, List $1895 .... $1695
810/serial & Centronics-style parallel interface, List $1940 .... $1735
810 w/full ASCII (U/LC), Vertical Forms Control, Compressed Print .. $1895
TI 820 KSR, List $2165 .... $1895
TI 745 w/full ASCII, List $1695 .... $1399
COMPRINT 912 w/parallel interface .. $ 559
912 w/serial interface, List $699 ...... $ 589
AXIOM IMP I .... $ 699
MICROTEK, List $750 .... $ 675
OKIDATA Microline 80, List $949 649
Tractor Feed Option .... $ 99
RS232 Serial Interface .... $ 89

NORTH STAR HORIZON®

(Call for North Star Specials)

HORIZON 1 KITS

16K, Double Density, List $1749 .... $1474
32K, Double Density, List $1999 ...... $1684
32K, Quad Density, List $2199 .... $1869

HORIZON 1 ASSEMBLED & TESTED

32K, Double Density, List $2695 .... $2279
32K, Quad Density, List $2995 .... $2539

HORIZON 2 KITS

16K, Double Density, List $2149 ...... $1824
32K, Double Density, List 2399 .... $2034
32K, Quad Density, List 2779 .... $2359

HORIZON 2 ASSEMBLED & TESTED

32K, Double Density, List $3095 ...... $2619
32K, Quad Density, List $3595 .... $3049
48K, Double Density, List $3590 ...... $3039
48K, Quad Density, List $4090 .... $3469
64K, Double Density, List $3830 ...... $3239
64K, Quad Density, List $4330 .... $3669

FLOPPY DISK SYSTEMS

NORTH STAR MDS-A
Assembled, List $899 ...... ***SPECIAL $ 719***
Kit Version, List $799 .... $ 669
MORROW THINKER TOYS® Discus 2D, List $1199 .... **OUR PRICE $1019***
Discus 2D, dual-drive, List $1994 ..... $1694*
Discus 2+2, A&T, List $1549 .... $1319*
Dual Discus 2+2, A&T, List $2748 ... $2335*
*Now includes CP/M® 2.2
MICROMATION Megabox, DD w/ 8" drives, 1-megabyte, List $2295 ..... $1949
2-megabyte, List $3095 .... $2629
MICROPOLIS 1041 MacroFloppy® w/enclosure (no P.S.), List $695 ...... $ 625
1042 MacroFloppy w/case & AC P.S. . $ 709
1053 Dual MetaFloppy® , List $1895 ... $1695

VIDEO BOARDS

I/O Mapped

SD COMPUTER VDB-8024,kit,List $370 $319†
Assembled, List $470 .... $ 399†
XITEX SCT-100K, Kit .... ONLY $154.95
SCT-100A Assembled $174.95
SSM VB2 I/O, Kit, List $169 .... $ 144
Assembled & Tested, List $234 ...... $ 199

Memory Mapped

SSM VB1C, 16x64, Kit, List $179 ...... $145
Assembled & Tested, List $242 .... $196
SSM VB3, 80-Char.,4MHz,Kit,List $399 $ 339
4 MHz, A&T, List $464 .... $ 394
INTERSYSTEMS, 16x64, A&T, List $165 $149

ESCON CONVERSION FOR IBM SELECTRIC

Complete w/microprocessor controller and power supply. Factory built. User installs solenoid assembly or it can be done at Escon factory at nominal cost.

Parallel (TRS-80, Sorcerer, etc.), $575 $514
RS232 Standard Serial, List $599 534
IEEE-488 (for PET), List $660 584
TRS-80 Cable 25

CPU BOARDS

(assembled unless noted)

NORTH STAR Z80A (ZPB-A/A), $299 $254
CROMEMCO 4 MHz (ZPU-W), List $395 $335
4 MHz (SCC-W), List $450 .... $382
INTERSYSTEMS (formerly Ithaca Audio)
new Series II Z-80, 4 MHz, List $395 ... $349
SSM CB1 8080 A&T, List $219 .... $186
CB1A Kit, List $159 .... $135
CB2 Z-80, A&T, List $275 .... $234
CB2 Kit, List $210 .... $179
DELTA Z-80, with I/O $289
SD SBC-100, List $350 .... $298†
SBC-100 Kit, List $295 .... $250†
SBC-200, List $400 .... $332†
SBC-200 Kit, List $320 .... $272†

MEMORY BOARDS

32K SD ExpandoRAM Kit
ONLY $249†
ONLY $159 without RAM chips
† Get $25 rebate from SD Computer when you buy any of their products prior to October 31, 1980.

NORTH STAR 16K Dynamic RAM Board, A&T (RAM-16-A/A), List $499 .... $420
16K Kit Version, List $449 ... **SPECIAL** $299
32K A&T (RAM-32/A), List $739 ...... $620
32K Kit, List $669 .... **SPECIAL** $499
CROMEMCO 16KZ-W, List $495 ...... $419
64KZ-W, List $1795 1485
MEASUREMENT SYSTEMS & CONTROLS
(Guaranteed performance, incl. labor/parts 1 yr)
DM6400 64K Board w/all 64K, $795 ... $659
DM4800 with 48K, List $695 .... $589
DM3200 with 32K, List $595 .... $509
DMB6400 64K Board w/all 64K $859
DMB4800 with 48K $789
MORROW SuperRAM — all static, all A&T
16K, 4 MHz or 2 MHz, List $349 .... $299
32K, 4 MHz, List $699 .... $629
16K Memory Master, List $399 .... $339
24K Memory Master, List $549 .... $465
INTERSYSTEMS (formerly Ithaca Audio)
8K Static 2 MHz, A&T, List $165 ...... $149
8K Static 4 MHz, A&T, List $195 ...... $176
16K Static 2 MHz, A&T, List $475 ..... $427
16K Static 4 MHz, A&T, List $495 ..... $445
64K Dynamic, List $995 .... $895
CALIFORNIA COMPUTER
16K Static, A&T, List $349.95 .... $259

FLOPPY DISK CONTROLLER BOARDS

NORTH STAR, DD, Kit, List $399 ..... $329
Assembled, List $499 .... $399
MORROW Disk Jockey 1, A&T ($213) . $189
Disk Jockey 2D, A&T, List $479 .... $429
SD Versafloppy 1, Kit, List $250 .... $212†
Versafloppy II, DD Kit, List $350 ...... $297†
Versafloppy II, DD, A&T, List $430 .... $365†
DELTA double density A&T ($385) $345
CONDUCTOR, double density A&T ... $269
INTERSYSTEMS FDC-2, A&T, $495 ... $439
MICROMATION Doubler, DD, A&T ... $399
TARBELL Floppy Disk Interface Kit $199
double density, A&T, List $495 .... $444

SHIPPING AND INSURANCE: Add $2.50 for boards, $6 for Selectric Converter or Floppy Disk Drives, $7.50 for Floppy Disk Systems, $15 for Horizon. SHIPPED FREIGHT COLLECT: SuperBrain, Centronics and T.I. printers. Contact us for shipping information on other terminals and printers.

Above prices reflect a 2% cash discount (order prepaid prior to shipment). Add 2% to prices for credit card orders, C.O.D.'s, etc. Prices are subject to change and offers subject to withdrawal without notice.

— WRITE FOR FREE CATALOG —

MiniMicroMart, Inc.

1618 James Street, Syracuse NY 13203 (315) 422-4467 TWX 710-541-0431

Circle 352 on inquiry card.

Unclassified Ads

FOR SALE: TDL Xitan system including TDL ZPU Z80 processor card; TDL SMB containing two serial ports, one parallel port, cassette interface, and 2 K Zapple monitor; Processor Technology VDM-1 video board; 16 K static programmable memory 250 ns; George Risk keyboard. Software includes 12 K BASIC, macro assembler, text editor, and text output processor. All documentation. $1200 or best offer. Paul Bajorek, 5482 Durrell Rd, Columbus OH 43229, (614) 436-0091.

FOR SALE: S-100 North Star Z80A processor board; $145. Godbout Econoram II 8 K programmable-memory board; $100. SD Systems VDB-8024 80 by 24 video display board; $275. Ithaca Audio 2708/2716 programmable read-only memory board; $50. Vector Pak enclosure with Vector Graphics mother board and power supply, fan, and 12 edge connectors; $290. Keyboard with ASCII encoder; $30. Everything assembled and tested. Will consider offers. Harry Haddon, 301 Orchard St, Apt A12, Fayetteville NY 13066, (315) 637-9229.

FOR SALE: XITEX video board with manual, new, assembled and tested, Model SCT-100; Jade Big Z processor with manual, assembled and tested by Jade, 2 MHz; 15-inch black and white monitor, like new; Sperry-Univac terminal/printer; new TEI 22-slot frame with Intersystems front panel, new; Tarbell floppy controller; KIMSI S-100 to KIM board with manuals. Ken Wong, 56 Hollywood Ave, Clifton NJ 07014, (201) 773-9033.

FOR SALE: Soroc IQ 140 terminal in original box; $995. IBM Selectric 731 I/O; $450. Bob Flaming, 6519 Jetta Ave, Bakersfield CA 93308, (805) 399-8968.

FOR SALE: Cromemco Z-2D computer. Factory assembled with extras. $3000 or best offer. Gregory Clifford, (305) 725-0562.

FOR SALE: Altair S-100 micro system, 17 slots, full display, control front panel, fan, 36 K programmable memory, 2 K programmable read-only memory (½ K unprogrammed), parallel I/O, video display interface, cassette interface, keyboard with power supply, serial I/O, real-time clock board, 8-channel priority interrupt, paper-tape reader mechanism, 5 K BASIC listing. All boards assembled and with documentation. $1185 or will accept offers on individual boards. Thomas T Moore, 505 Fulton Pl, Lansing MI 48915, (517) 485-6783.

FOR SALE: BYTE back issues; #1 thru #16, in binder, excellent condition, make offer. 1977 and 1978 complete, $15/year. T Good, 3 Bergen Ave, Hillsdale NJ 07642.

DONATION: Will donate a Clary DE-60 computer with IBM Model B typewriter printout for eligible charitable deduction. Includes program boards for general engineering and surveying, mahogany console. H K Friedland, POB 893, Solana Beach CA 92075, (714) 481-9339.

FOR SALE: TDL with 8-inch disk drives. TDL Alpha-2 with Z80 ZPU, SMB with Zapple monitor, dynamic 16 K programmable memory, iCOM disk board, case, 8-slot mother board. iCOM FD3712 dual 8-inch disk drives with cabinet, power supply. TDL BASIC, text editor, macro assembler, word processor; iCOM's FDOS, DEBBI BASIC, assembler, text editor; and CP/M. Hardware and software manuals included. $2700. John French, 8045 Alida St, La Mesa CA 92041, (714) 466-5915.

FOR SALE: 2400 bps synchronous modems. Tele-Signal 883P; 2.0, 1.2, and 1.0 k bps options, switched network or leased. RX: echo delay, compromise delay, slope equalization. TX: answer tone, manual or automatic control. Equivalent to Bell 201. SASE for data sheet. Single units (3) $135; double unit in rack panel (1) $200. Full documentation. Dan Dolan, POB 23191, Lexington KY 40503.

WANTED: Copy of documentation or manual of Digital Group Phi-Deck controller, version A. Ray Johnson, 2758 Sheridan Way, Stockton CA 95207.

WANTED: Back issues of BYTE. All issues of Volume 1 and November 1978 issue. Must be in excellent condition. R Tellier, 943 Dyer Ave, Cranston RI 02920.

INTERNATIONAL CLEARING HOUSE: We use TRS-80 Level II, PET, and Apple for computer-aided Instruction (CAI) programs and educational programs. Send us your noncommercial CAI programs in any subject and receive a similar quality program in exchange. State three priorities (eg: 1. Algebra 2. German 3. Biology, TRS-80 Level II cassettes in English). We represent a successful nonprofit Computer Cooperative at Lisgar Collegiate Institute. Barter is a fantastic way to double your library for the cost of the tape and postage. The Microeducator Exchange, 29 Lisgar St, Ottawa Ontario, K2P 0B9 Canada.

WANTED: I wish to purchase a Z80, 8080 S-100 type computer. It does not need to work. It could have dual disk and a video display. I have ham equipment for trade. Dale Hutchinson, 10818 Brentway Dr, Houston TX 77070, (713) 469-2584.

UNCLASSIFIED POLICY: *Readers who are soliciting or giving advice, or who have equipment to buy, sell or swap should send in a clearly typed notice to that effect. To be considered for publication, an advertisement must be clearly noncommercial, typed double spaced on plain white paper, contain 75 words or less, and include complete name and address information.*

These notices are free of charge and will be printed one time only on a space available basis. Notices can be accepted from individuals or bona fide computer users clubs only. We can engage in no correspondence on these and your confirmation of placement is appearance in an issue of BYTE.

Please note that it may take three or four months for an ad to appear in the magazine.

WANTED: Used KIM for multiprocessor experimentation. Only for $90 or less. It can be broken if it is inexpensive. Chris Pino, 63 7th Ave, Brooklyn NY 11217, (201) 622-8642.

FOR SALE: Complete ready-to-go SwTPC system: 30 K Heathkit terminal, AC-30, JPC TC-3 4800 bps tape interface with CFM-3 operating system on eprom. Eprom board, eprom programmer, D/A board, PR-40 printer, three extra eproms. All documentation, assembly instructions, and user guides. Lots of software including BASIC, Assembler, many games, and music board. $1750 or best offer. Send certified check or money order. Steve Wright, 13900 SE Hwy 212 #73, Clackamas OR 97015.

FOR SALE: Assembled and tested SD Expandoprom for $50, and homebrew S-100 2708 burner for $45. SSM music synthesizer kit for $110. Bare boards: S-100 extender for $12, and SSM VB1B video for $22. PDP-10 schematics and maintenance manuals for $5. IBM 360/50 hardware theory and microprogram flowcharts for $10. All postpaid in 48 states. Stephen Wiebking, 1617 Stockton Trl, Plano TX 75023.

FOR SALE: OSI system. Challenger 2P. 12 K programmable memory expandable to 28 K. Read-only memory BASIC. PIA installed. Sound, joysticks, and more. Assembler, Disassembler, and Extended Monitor; $600. Leedex 100 video monitor; $110. Digital cassette recorder; $30. All for $720. Will consider best offer. For more information send SASE. Clinton Laskowski, 3631 E Underwood Ave, Cudahy WI 53110, (414) 482-0715.

WANTED: Original or copy of Microsystems International MF8008 Applications Manual, Bulletin 80007. Also, need schematics etc for a Digi-Data 9-track tape deck. I have schematics for a Dura Mach-10 which may prove helpful to someone with a correspondence-coded machine. Gary Simpson, 4891 Amboy, Memphis TN 38117.

FOR SALE: Korn's *Minicomputers for Engineers and Scientists*, in essentially new condition, for $15 plus postage COD. No answer to your letter, book already sold. J B Green, 307 W 45th, Austin TX 78751.

FOR SALE: Radio Shack Editor, Assembler, Mailing List, and Inventory Control I programs for TRS-80 Model I, Level II. Half price. Tony Nelzen, 524 Simpson, McPherson KS 67460.

FOR SALE: Micromation Megabox. Two double-density drives. Disk controller for S-100 bus. New/never used. Cost $2300. Will sell for $1800 or best offer. Jim Fritz, 1413 Harmony Ln, Annapolis MD 21401, (301) 757-7019.

FOR SALE: 16 K Level II TRS-80 with keypad. New; under warranty. $700. John Abraham or Joe Gutierrez, POB 3945, McAllen TX 78501, (512) 687-2329 or (512) 682-6731.

FOR SALE: Trendcom 100 printer with interface for the Apple II, including four rolls of paper for $300. Art Mena, 10414 Rutgers Ct, Cypress CA 90630, (714) 761-2585.

FOR SALE: Cromemco Z-2 system with Dazzler, Tu-Art, 8 K Bytesaver, 8 K Seals programmable memory, Seattle 16 K plus programmable memory, 16 K eprom board, and Percom 300 thru 2400 bps KC cassette board. Software includes Cromemco Monitor, 3 K and 16 K Extended BASIC in eprom, TSC's Text Editor/Processor, and other software on cassette. Accessories and documentation included. Over $2200 new, $1500 or best offer. William Brady, 156 Drakes Ln, Summertown TN 38483, (615) 964-2222 days.

FOR SALE: Heath H8 4 K, assembled, no extras, and in working condition; $369. Cherry Pro keyboard; $110. Tiny-c; $30. XITEX video terminal interface kit (partial); $89. Everything for $585. All equipment in Northbrook, Illinois. Tom, (217) 224-6244.

FOR SALE: Hazeltine Mod One terminal. Detachable keyboard, addressable cursor, local edit mode, eight function keys, numeric keypad—many features. A first-class terminal in new condition. $1075. Marty Cawthon, 24224 Michigan Ave, Dearborn MI 48124, (313) 565-4000 or (313) 565-2286.

FOR SALE: SwTPC CT-64 terminal, assembled and tested; $250. SwTPC 8 K static programmable memory, assembled and tested; $100. Chuck Duff, 7007 N Sheridan Rd, Apt 317, Chicago IL 60626, (312) 996-5523 days, (312) 465-8152 evenings.

FOR SALE: SD Expandoram 64 K unassembled kit; $210. Uses 4116s. Call for shipping arrangements. Sanjeev K Katyal, 990 Fairfield Dr, Marietta GA 30067, (404) 971-4636.

WANTED: For Video Brain Model 101A: APL/S cartridge, documentation, schematics, and information. Will correspond with other owners. Kendall Stambaugh, 5009 Guide Meridian Rd, Bellingham WA 98225.

WANTED: TRS-80 Level II programs to swap. Games, home, business programs. Send tape or listing with your address. Douglas Collimore, 31 Melisa Ct, Southington CT 06489.

FOR SALE: PET 8 K old-style computer. Like new condition, includes all purchased software. $550 pays for computer and freight. Steven Shaw, 4521 Leona St, Tampa FL 33609, (813) 837-6591.

FOR SALE: Digital Group Z80 computer. Complete system or pieces. Following available: Z80 processor card, three 8 K static-memory boards, dual 8-inch Shugart floppy drives with dress cabinet, cable-controller card, two Phi-Deck cassette drives with dress cabinet, cables, controller card, TVC-64 board, MON-9D display, keyboard (KEY1), IOF board, COMM4 board, processor dress cabinet, 18 A power supply, and other stuff. Brian Gravenhorst, 710 W Roscoe, Chicago IL 60657, (312) 470-4599 9 AM thru 5 PM CT weekdays.

BOMB

BYTE's Ongoing Monitor Box

Article #	Page	Article	Author
1	26	Build a Low-Cost, Remote Data-Entry Terminal	Ciarcia
2	46	An 8088 Processor for the S-100 Bus, Part 1	Cantrell
3	76	Dissecting the TI Speak & Spell	Rigsby
4	86	Penny Pincher's Joystick Interface	Wexler
5	102	Machine Problem-Solving, Part 1: Trial and Error Search, A Plan to Save the Missionaries	Frey
6	116	APL Character Generator	Langer
7	126	Construction of Fourth-Generation Video Terminal, Part 2	Wierenga
8	180	FCC Regulation of Personal Computers and Home Computing Devices	Mahn
9	206	Varieties of Threaded Code for Language Implementation	Walker
10	230	Education Forum: New Cultures From New Technologies	Papert
11	242	Khachiyan's Algorithm, Part 2	Berresford, et al
12	270	Exploring Ballistics With Your Computer	Jenks
13	282	An Interrupt-Driven Real-Time Clock for the TMS 9900	Morris
14	328	A BASIC Floppy-Disk Accounting System	Roehrig

Data From the BOMB Output Port

June BYTE readers communicated their approval of Steve Ciarcia's "I/O Expansion for the TRS-80, Part 2: Serial Ports." An above-average number of responses gave Steve a well deserved first place at 1.51 standard deviations above the mean. Congratulations are also in order to Ronald Parsons for his excellent article "An Answer/Originate Modem," which placed a close second at 1.35 standard deviations above the mean.

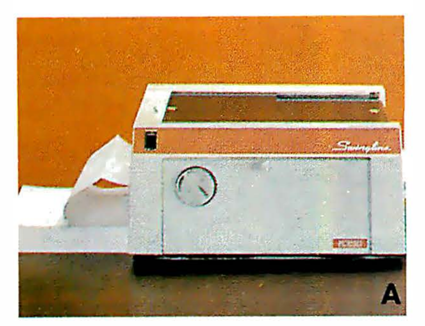
Reader Service

*To get further information on the products advertising in BYTE, fill out the reader service card with you name and address. Then circle the appropriate numbers for the advertisers you select from the list. Add a 15-cent stamp to the card, then drop it in the mail. Not only do you gain information, but our advertisers are encouraged to use the marketplace provided by BYTE. This helps us bring you a bigger BYTE. *Correspond directly with company.*

Inquiry No. Page No.

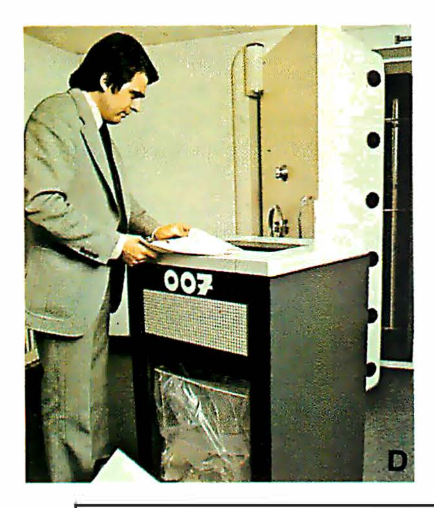


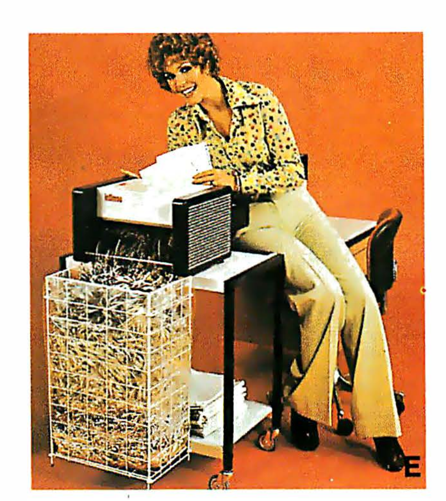
A COMPANY TO RELY ON. . . UNITED BUSINESS PRODUCTS













UNITED BUSINESS PRODUCTS
20268 E. Carrey Rd.
WALNUT, CA. 91789



(213) 448-4850

(714) 594-5966

NAME OF COMPANY ______

ADDRESS ______

CITY, STATE, ZIP ______

ATTENTION OR DEPT. ______

A ☐ The swingline table top burster will separate single-ply continuous forms into individual sheets up to 15". Length 2⅝" to 12". Paper weight 10 to 110 lb. bond. Speed is constant at 125 ft. per minute.

Wt. 95 lbs. **Price $ 899.00**

B ☐ Our custom forms have a guarantee that speaks for itself. Our time on forms range from two to five weeks for custom work and before we start a job we now give a guaranteed shipping date and price, depending on art work, from two to five weeks and for everyday we're late we give you a 10% discount. To get a quote just mail the detached portion of this ad with sample of form or layout and we will call you the day we get the information with a price and guaranteed day of shipment.

C ☐ The swingline table top decollator is a portable unit which separates both carbon and carbonless continuous computer forms into stacks. The separated carbon is easily and neatly removed from carbon pick-up spool. Form size is up to 15" wide. Wt. is 10 to 110 lb. bond paper, and the speed is variable from 75 to 200 feet per minute and takes only 120 volts AC 60 hertz to operate.

Wt. 40 lbs. **Price $ 419.00**

D ☐ The Datatech Intimus 007 shredder works for Scotland Yard, for government authorities, for important corporations, banks and embassies. The cutting capacity is 12 to 14 sheets at one pass. Cross cut is 1/35 x 3/8. It has a 2 H.P. motor and runs off of 220/380 V 3 phase.

Wt. 320 Lbs. **Price $6799.00**

E ☐ The Intimus 306 is designed for trouble free operation and has a switch for forward and reverse rotation. It has 2 motors with terminal overload. Housing consists of coated steel, mounted on rubber cushions for noiseless shredding. The 306 can sit on a table or a stand. Cutting width is ⅛" or ¼" and has two 150 watt 110 V 60 cycle, 1 phase motors.

Wt. 66 Lbs. **Price $1199.00**

F ☐ The Intimus Simplex is designed for security without problems in the office. One push of the button renders confidential information into five illegible paper strips ⅛" thin. The simplex has a wide opening in the middle for throwaway of cans, etc. Even a paper clip is simply cut into pieces. The cutting capacity is 8 to 10 sheets at one time. It has a 1/5 H.P. motor and runs off of 110 volts.

Wt. 27 Lbs. **Price $ 599.00**

G ☐ Our catalog consists of more information on equipment in this ad. Other models are available plus a complete line of calculators and typewriters by Adler, Lathem time recorders, several varieties of safes, and our disintegrator that destroys paper, aluminum, film and carbon to a complete loss of identity.

Price $2.00

H ☐ Free Brochures and more information:
1. ☐ Business Forms
2. ☐ Calculators
3. ☐ Forms Handling Equipment
4. ☐ Time Recorders
5. ☐ Typewriters

Terms: Check or money order U.S. funds only. Prepaid orders add 3% S/H, COD's add 5% S/H (U.S.only). California residents add 6% sales tax.

master charge THE INTERBANK CARD


Prices subject to change without notice.

VISA

Circle 354 on inquiry card.

Ohio Scientific: The leader in Winchester based micro-computers.



Ohio Scientific produced the first large capacity fixed media hard disk (Winchester) based microcomputers in 1977. Since then we have shipped more of these systems than the rest of the microcomputer industry combined.

Family Features
All standard C3 features including:
- 3-processor CPU with 6502, Z80 and 6800
- .7 MIPS 6502A
- 48K static RAM
- Dual 8″ floppies
- Free standing rack for direct expansion capabilities
- 17-slot OSI 48 line BUS architecture for large system expansion
- Directly accepts up to 8 users with currently available memory boards, more with higher density boards in the future
- Directly expandable for use as Network data bases
- Slide-mounted subassemblies, removable side panels and locking rear door for easy expansions and service.

C3-A
The floppy only rack based C3 for users who anticipate expansion to hard disk, multi-user and/or networking in the future. **Under $7000.**

C3-B
The world's most powerful microcomputer (when GT equipped). Features the highly advanced and extensively field proven OKIDATA 3306 Winchester disk.

Features
- System boots from floppies or hard disk on power up
- 74 megabytes end user workspace under OS-65U, 80 megabytes unformatted
- Ultra-high performance disk
  74 millisec worst case access
  38 millisec average
  10 millisec access on cylinder (215K user workspace)
  8 megabits per second transfer rate
- Simple on/off disk operation with elaborate internal protection from improper temperature, line voltage and controller failures
- Features spindle brake and designated head landing areas for much longer operational life than the newer low-cost Winchesters
- Highly advanced OS-65U operating system:
  Multiple level pass word security
  Multiple operating systems on disk
  Ultra-high speed "FIND" command for high speed string searches (Associative Access)
  Upward compatible with multi-user and network systems with full file, peripheral and communications arbitration between users
- Available factory configured for up to 8 users and network data base operation
- Expandable to CP/M operation by adding 4K (CM-2 memory) **Under $14,000**

C3-C
A medium performance Winchester disk based system which provides the ideal cost/performance ratio in typical small business applications. The C3-C uses the Shugart SA4008 29 megabyte Winchester disk.
Performance specifications, hardware configuration and software is identical to the C3-B with the following exceptions:
- 23 megabytes of end user workspace under OS-65U
- 29 megabytes unformatted capacity
- Medium performance Winchester
  240 millisec worst case access
  87 millisec average access
  10 millisec access on cylinder (110K user workspace)
- Simple on/off disk operation **Under $11,000**

Ohio Scientific has a new OEM program that is easy to start with, and provides generous discounts for quantity purchases.

For literature and the name of your local dealer, CALL 1-800-321-6850 TOLL FREE.



1333 SOUTH CHILLICOTHE ROAD
AURORA, OH 44202 • (216) 831-5600

Circle 355 on inquiry card.